LAW AND CONTEMPORARY PROBLEMS

ATOMIC POWER DEVELOPMENT

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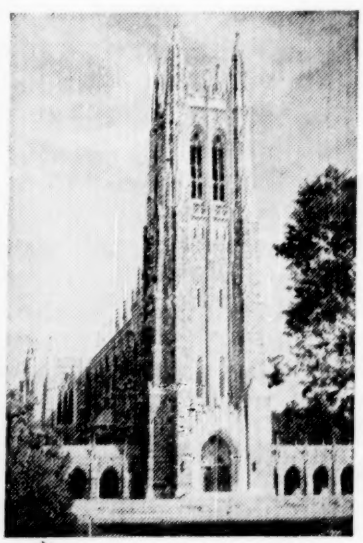

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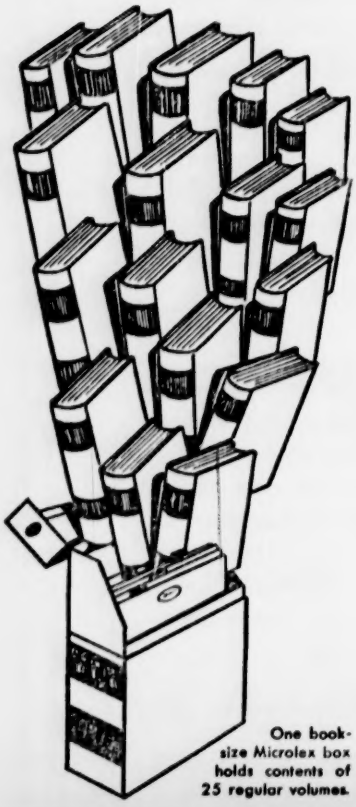

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LAW AND CONTEMPORARY PROBLEMS

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FOREWORD

In his never-ending quest to control his physical environment, perhaps man's most epochal achievement has been his tapping of the elemental forces within the atom. Born, so to speak, of military necessity barely a decade ago, this innovation was immediately conceived to possess enormous constructive as well as destructive potential. Accordingly, as martial demands grew less insistent, attention, energies, and resources were increasingly turned to exploration of the atom's peaceful applications. More advanced and effective techniques for exploiting atomic energy have been devised and refined, and myriad new uses have been investigated and confirmed —but of all developments, perhaps the most significant has been the successful harnessing of the atom to the generation of electricity, the universal vade mecum of a better material life.

This, of course, is not to say that the day of cheap and abundant atomic power has already arrived. Far from it. But it is dawning. Critical technical obstacles have been and are being overcome; and though the surface may be said scarcely to have been scratched, sufficient data have been compiled to permit educated—and optimistic—estimates of feasibility under various assumptions for the not-too-distant future.

Almost as challenging in its own way as the technical problems faced has been the task of devising an institutional framework in which this evolving atomic technology may best be fostered, consistent with national security and other competing policy interests. The Atomic Energy Act of 1954 represents at least an interim solution, and it is primarily to an examination of some of its more salient and controversial features that this symposium is directed.

Since termination of military control in 1946, direction of atomic energy matters has largely been vested in the Atomic Energy Commission. Originally launched as an operating agency, the Commission has since acquired, by virtue of the 1954 act, regulatory and promotional duties as well. This confusion of functions has caused complications and has raised some question as to the propriety of the Commission's administrative structure and organization for its new role in atomic power development.

Individuals and special interest groups other than the Atomic Energy Commission have also had a hand in shaping our atomic energy policies—most prominently, Congressional Joint Committee members, military officials, and the President and his advisers. Their philosophies, their interrelationships, and the effectiveness with which they make themselves felt profoundly have influenced and will influence the course of atomic power development.

One of the most difficult and delicate problems in this area, because of its extensive ramifications, has been determination of the manner in and the conditions under which the results of extensive publicly-sponsored nuclear research should be made available to private interests. Unearned increments, in the form of technical know-how, were accruing to the large atomic energy contractors, further enhancing their inherent comparative advantage in this infant industry. Some equalizing mechanism was strongly indicated, and the information control and patent provisions of the 1954 act have been the guises it principally assumed. The extent to which these provisions have successfully accommodated the somewhat antithetical values of national security, broad dissemination of technical information, and stimulation of rapid technological advancement, however, seems to be open to some question.

Not surprisingly, in light of its pervasive significance, atomic power development has acquired strong political overtones, both domestically and internationally. The always-explosive public-power issue has intruded itself via the preference provisions of the 1954 act, which, although somewhat attenuated, have a not inconsiderable import for the future. And the international implications of atomic power development—its interaction with our foreign policy and the manner in which it can and should be employed to further both our national interests abroad as well as the cause of world peace—are perhaps the most crucial aspect of this whole subject.

Finally, there is the problem in our federal system of precisely defining the relationship between the national and state governments and accurately delineating the proper scope of operation of each so as most effectively to create a "climate" conducive to optimal development of this new technology.

This symposium is not—nor, indeed, does it pretend to be—exhaustive, even in these few areas it touches. Nevertheless, it is hoped that it will limn, however skeletally, the outlines of atomic power development to date and in the foreseeable future, conveying some of its technical, administrative, economic, legal, and political flavor, and thus promoting greater understanding and appreciation of the bright promise this imminent revolution portends.

MELVIN G. SHIMM.

THE FACTS OF ATOMIC POWER DEVELOPMENT: SOME ASPECTS OF NUCLEAR POWER ECONOMICS*

DELBERT M. LEPPKE†

I

Before discussing the economics of atomic power development, it seems desirable that fundamental concepts and terminology be established and defined in terms comprehensible to the nontechnical reader. Accordingly, this discussion will be prefaced by a brief description of the fission process and the type of mechanical gadgetry which accompanies its commercial utilization.

In the production of electrical energy today, we customarily use such fossil fuels as coal, oil, and gas, from which, by chemical reaction with the oxygen of the air, heat energy is released. This heat energy is used to boil water and produce steam. The steam, in turn, is passed through a turbine, the rotating shaft of which is coupled to a generator which produces electricity for transmission to consumers.

Where nuclear fuels—uranium and plutonium—are used, the pattern is quite similar. Significant changes, in fact, are found only in the steam generating unit—reflecting the fact that heat energy is here released not as a result of a chemical reaction, as is the case with fossil fuels, but as a result of a nuclear reaction called fission, in which the basic elemental characteristics of the atom are changed.

Briefly, fission is that reaction in which a neutron strikes the nucleus, or center of a fuel atom, causing it to split into two separate atoms. As the rupture occurs, heat energy is released, and two to three new neutrons are emitted. These neutrons may then go on to split other fuel atoms, initiating a chain reaction.

Since the neutrons emitted when an atom is split may be captured by nonfissionable material or lost to the surrounding atmosphere, one of the basic requirements for an atomic reactor is that sufficient fissionable fuel—in nuclear terminology, a critical mass—be present so that at least one neutron per fission is captured by another fuel atom. If this occurs, a chain reaction will ensue and a sustained amount of heat energy be released. This requirement of a critical mass is one of the most important concepts affecting atomic power economics. Since the critical mass exceeds the daily fuel requirement about a thousandfold, and since the cost of nuclear fuel is about $9,000 per pound, a substantial fuel inventory charge must be borne as part of the cost of producing electricity.

* The author wishes to acknowledge the very helpful suggestions given by Mr. Theodore Stern of the Foster Wheeler Corporation in the preparation of this paper, as well as the assistance received from the companies developing atomic power plants.

† B.S. 1951, South Dakota State College; Graduate 1952, Oak Ridge School of Reactor Technology. Nuclear Engineer, Pioneer Service & Engineering Company, since 1952; Assistant Technical Director, Nuclear Study Group, Foster Wheeler Corporation—Pioneer Service & Engineering Company—Diamond Alkali Company, since 1954.

When the fuel atom splits, the resultant new atoms are called fission products. They also will capture neutrons but will not themselves split. Accordingly, if they continue to remain in the fuel, ultimately fewer neutrons will strike fuel atoms and the chain reaction will cease. As a result, the nuclear fuel must be removed from the reactor periodically to remove the fission products and/or add new fuel. Unlike coal, for example, another shovelful of nuclear fuel cannot be thrown into the reactor and be permitted to burn to ash. The effect of fission products, thus, is another basic concept which directly affects atomic power economics, in that fuel reprocessing facilities and operating charges become an important part of the cost of producing electricity.

Another important concept affecting atomic power economics is the effect of a fertile material. Two elements—thorium and one of the isotopes of uranium—although they are not themselves fissionable, are transmuted, on the capture of neutrons, into fissionable fuel. They are known as fertile materials, and can either be mixed with the fuel (in which case, the term internal conversion is applied) or placed around the fuel (in which case, they are called blankets). The presence of a fertile material can affect atomic power economics in that it can lengthen the time between fuel processing periods, thereby decreasing the annual costs for fuel handling, fabrication, and reprocessing; and it can also effect the production of new material which, after removal from the reactor, can be used for a continuous supply of new fuel or can be sold at a premium price for special uses, such as weapons.

These three concepts are the important features of nuclear fuels that affect the operating costs of atomic power plants. Other concepts primarily affect capital costs. After heat energy is released from the nuclear fuel, it must be harnessed to boil water and produce steam. Without going into detail, it is evident that this could be done in innumerable ways. Basically, however, the structure in which the reaction occurs—the reactor—must meet the following specifications:

1. The fuel must be subdivided by some means that allows the heat from the fissioned atoms to be transferred to some other medium.
2. The fuel must be supported in its critical configuration so that a chain reaction may occur. Since structural materials capture neutrons without producing fission, it is desirable to use them in as small amounts as feasible, consistent with the demand for support or rigidity; also, since many of the so-called conventional structural metals have a comparatively high affinity for neutrons, the use of many less conventional structural metals is indicated.
3. The fission products, which are highly radioactive, as are other materials which capture neutrons, must be contained so that they are not dispersed outside of the reactor.
4. An adjustable means to control the speed of the chain reaction must be incorporated in the reactor so that the heat release may be equated with the demand for electricity from the plant.

5. Surrounding the reactor, there must be biological shielding to protect the operators from nuclear radiations produced by the neutrons; and around the entire plant there must be either sufficient uninhabited land or a secondary container to protect the public from radioactivity in the event of a reactor failure.

The nuclear fuel, its structure, the reactor, the shield, and associated equipment and controls necessary to produce steam constitute the steam generating unit; and it is this unit alone that is new to power-producing technology. The basic design problem of the atomic power plant manufacturer today, then, is to select, from the multitude of ways to meet the basic requirements, a practical design for a nuclear-fueled steam generating unit that can be built with sufficient integrity, yet at a minimum cost.

II

Evaluation studies of experimental atomic power plants indicate that five design approaches, described in Table I, have today advanced to the stage where commer-

TABLE I

ATOMIC POWER PLANT DESCRIPTIONS

Type of Plant—Pressurized Water

Being Developed Commercially by The Babcock & Wilcox Co. for Consolidated Edison, near Peekskill, New York.

Brief Description—

Enriched uranium fuel† and thorium fertile material, as the metal, are suspended in a pressure vessel filled with water. The water serves as a moderator• for the neutrons involved in the chain reaction. This same water, pressurized to prevent boiling, is circulated past the fuel and fertile material to transfer the heat energy. As it leaves the reactor it is passed through a heat exchanger-boiler where steam is produced. This steam is then passed through a separate oil-fired superheater. Finally, the steam at 1000° F. is put through a turbine-generator where the energy is converted to electricity.

Type of Plant—Boiling Water

Being Developed Commercially by General Electric Co. for Commonwealth Edison and associates, near Chicago, Illinois.

Brief Description—

Slightly enriched uranium fuel† or enriched uranium and thorium, as the metal, are suspended in a pressure vessel partially filled with water, which serves as a moderator•. In this reactor, the pressure is not maintained as high as in the pressurized water reactor, no theat the water boils in the reactor. The steam produced in the reactor is then passed directly to the turbine-generator. Some feature such as a flash boiler or feedwater temperature control is used in conjunction with this reactor to control the amount of sub-cooling in the reactor-boiler. Controlling the sub-cooling regulates reactor power. Saturated steam at 600 psi, 486° F., is used to operate the turbine-generator producing electrical energy.

Type of Plant—Sodium-Graphite

Being Developed Commercially by North American Aviation Co. for Consumers' Public Power District of Columbus, Nebraska.

Brief Description—

Slightly enriched uranium fuel† or enriched uranium and thorium, as the metal, is suspended through channels in a large structure of graphite. The graphite is the moderator• for this reactor. Liquid sodium is pumped through the channels past the fuel and fertile material. The energy released from fission is transferred to the sodium, which then passes through a superheater and steam-generator producing steam at 825° F. This steam is used in a turbine-generator set to produce electricity.

Type of Plant—Aqueous Homogeneous

Being Developed Commercially by Foster Wheeler Corporation; also more recently by Westinghouse Electric Corp. for Pennsylvania Power & Light Co.

Brief Description—

Enriched uranium† is dissolved in a heavy water solution. The heavy water serves as both the moderator* and heat transfer medium. This fuel solution is pumped through a pressure vessel which has a configuration that will allow a chain reaction to occur. The heat is released directly in the fuel solution. This solution is then circulated to heat exchanger-boilers where the heat energy is used to boil water producing saturated steam at 600 psi, 486° F. A slurry of thorium is also circulated, either as a separate blanket system or integral with the fuel solution. The heat release in this system is also used to produce steam. The combined steam sources are used to operate a turbine-generator set.

Type of Plant—Fast Breeder

Being Developed Commercially by Atomic Power Development Associates for Detroit Edison and associates, near Detroit, Michigan.

Brief Description—

Enriched uranium† with natural uranium as blanket material—all in the metallic form—are suspended in a vessel which contains liquid sodium. This reactor has no moderator*. Therefore, the physical principles and kinetics are different than in the thermal reactors. Nevertheless, from an engineering viewpoint, this reactor is similar in that the sodium is circulated past the fuel elements where the heat energy released by fission is transferred to the sodium. The sodium then flows through heat exchanger-boilers where steam at 730° F. is produced. The steam, again, is used to operate a turbine-generator set.

* The moderator is usually some light element, such as hydrogen, heavy hydrogen, or graphite, which reduces the kinetic energy of the neutrons after they are released from fission and before they are captured by the fuel. As the neutrons are reduced in energy, there is a greater probability that the surrounding fuel will capture them to produce new fissions. As a corollary however, there is also a greater probability that the structural material will capture them. A reactor using a moderator is called a thermal reactor because the energy of fission neutrons is reduced to an energy which is in equilibrium with the thermal vibrations of the constituent atoms. New fissions are produced using thermal neutrons. A reactor without moderating material is called a fast reactor because the neutrons are used at the high energies, or while they are still fast.

† Enriched uranium refers to uranium enriched in the fuel isotope, U-235. Since natural uranium has only .7% U-235, the balance being constituted of nonfissionable U-238, it is often advantageous thus to increase the U-235 concentration.

cial development appears to be imminently feasible. It is the intent of the writer to present some of the cost data developed by manufacturers of these plants and to discuss the factors which may modify these presently estimated figures. Secondly, the writer hopes to point out some of the limitations that must be acknowledged in extrapolating the cost data of this interim period in the history of atomic power development. And lastly, some comparisons will be drawn concerning the competitive position of nuclear and fossil fuels.

CAPITAL COSTS

The broad range of estimated capital costs, as set forth in Table II, is attributable to many factors. Apart from inherent physical differences among the plants and the varying amount of work that the AEC has already undertaken with respect to each, one of the most significant of these factors is the fact that in each case, the manufacturer has adopted a different method of writing off developmental costs. From AEC experience, as well as from experience in more conventional industries, it is not improbable that the developmental costs of a new plant may be one hun-

TABLE II

ESTIMATED CAPITAL COSTS

Type of Plant	Size (In Kilowatts)	Capital Cost (In thousands of dollars)	Cost per Kilowatt
Pressurized Water	236,000	$55,000	$233
Boiling Water	180,000	45,000	250
Sodium-Graphite:			
Uranium fuel	75,000	22,500	300
Uranium-thorium	100,000	26,500	265
Aqueous Homogeneous	100,000	21,000	210
Fast Breeder	100,000	45,000	450
Conventional Coal	100,000	16,566	166

dred per cent or more of the actual construction costs. Accordingly, charging these costs in their entirety to the first plant certainly does not indicate what might be the cost of other plants of the same type, if we can expect more to be built in the near future. Therefore, perusal of the estimated capital costs of these first plants may be misleading unless one has some estimate of the developmental costs included and a measure of the amount by which they may be decreased as subsequent plants are built. These data are difficult to obtain, however, since their determination is governed by internal company policy and since changes in reactor technology are occurring so rapidly that no concise approach to the proration of developmental costs can be formulated at present. In addition, manufacturers have had to build new facilities or extend existing ones, hire new personnel, and reorganize their working arrangements, and the extent to which these factors have contributed to the costs of first plants cannot accurately be determined.

TABLE III

ESTIMATED OPERATING COSTS
(In Mills per Kilowatt-Hour)

Type of Plant	Capital Charges (at 16%)	Labor and Maintenance	Fuel* Inventory	Fuel† Operating	Total
Pressurized Water	5.4	1.0	0.2	2.0	8.6
Boiling Water	5.7	0.8	0.2	1.7	8.4
Sodium-Graphite:					
Uranium fuel	6.9	2.0	0.45	2.0	11.35
Uranium-thorium	5.8	1.5	0.5	1.5	9.3
Aqueous Homogeneous	4.8	2.0	0.2	1.2	8.2
Fast Breeder	10.0	1.0	0.5	−0.2‡	11.3
Conventional Coal	3.8	0.6	negligible	3.0	7.4

*Fuel inventory charges are based on the existing price policy of the AEC.

†The fuel operating charge includes charges for fuel and fertile material fabrication, fuel and fertile material handling, reprocessing, and the purchase of new material to replace that which has been burned up or lost in the process. If the reactor produces new fissionable material, any credit for the sale or recovery of that material is deducted from the charges listed.

‡Since the fast breeder can produce high-grade fissionable material in excess of that needed for fuel, the credit for sale at a premium more than exceeds the fuel operating charges. A breakdown of charges and credits is as follows: fuel operating charges 5.6 mills, credit for sale of new fissionable material 5.8 mills. This condition would be drastically changed if the premium price for high-grade fissionable material were canceled or reduced.

In order to arrive at some figures that will indicate the magnitude of cost reductions necessary to render nuclear fuels competitive with fossil fuels, the effects of capital and operating costs will be separated by making certain arbitrary assumptions. The possibilities for reduction in each of these categories can then be discussed as they apply to the plants now under design.

Let us assume, then, that operating costs will remain the same, as estimated in Table III. Further, let us assume that atomic power will become competitive when total production charges are brought below eight mills per kilowatt hour. It is now possible to calculate the magnitude of the reductions in capital costs necessary to produce power at a cost nearly competitive with the power produced from fossil fuels. Reductions in operating costs would lower electrical production charges still further so that a definitely competitive position would be established. Table IV summarizes these calculations.

Examining Table IV in the light of a convenient cost breakdown for atomic power plants, the percentage capital cost reduction necessary to make these plants

TABLE IV

THE DIFFERENCE BETWEEN ALLOWABLE AND ESTIMATED CAPITAL COST

Type of Plant	Revenue Available for Capital Charges (In mills per kw-hr)	Equivalent Capital Cost	Estimated Capital Cost	Difference
		(In Thousands of Dollars)		
Pressurized Water	4.8	48,889	55,000	6,111
Boiling Water	5.3	41,841	45,000	3,159
Sodium-Graphite:				
Uranium fuel	3.55	11,576	22,500	10,924
Uranium-thorium	4.5	20,560	26,500	5,940
Aqueous Homogeneous	4.6	20,150	21,000	850
Fast Breeder	6.7	30,200	45,000	14,800

competitive can also be calculated. Since some components of the atomic power plant are rather conventional it would be unreasonable to assume that much developmental cost will be encountered in those areas. Accordingly, for our purposes, an atomic power plant may be divided into three major components: site and structure, steam generating plant, and steam-electric conversion plant. An average cost breakdown, applicable to all power plants, would be:

	Atomic
Site and Structure	25%
Steam Generating Plant	40%
Steam-Electric Plant	35%

Assuming, then, that the cost of structures and steam-electric plant will not be greatly changed by continued development, as they are quite similar to conventional equipment, the percentage capital cost reductions in the steam generating plant that

TABLE V

NECESSARY COST REDUCTION IN STEAM GENERATING UNIT

Type of Plant	Reduction Necessary	Estimated Cost Appropriated to Steam Generator	Percentage Reduction Necessary
	(In thousands of dollars)		
Pressurized Water	6,111	22,000	28%
Boiling Water	3,159	18,000	18%
Sodium-Graphite:			
Uranium fuel	10,924	9,000	121%
Uranium-thorium	5,940	10,600	56%
Aqueous Homogeneous	850	8,400	10%
Fast Breeder	14,800	18,000	82%

would render atomic power competitive can be calculated. An analysis of these figures, as set forth in Table V, in the light of possible developmental costs attributed to the first plants, would seem to indicate that it is not unreasonable to expect that continued manufacture of atomic power plants will soon effect these reductions.

Another factor which must be considered in connection with the reduction of capital costs is the possibility of increasing power output from the reactor by overcoming existing temperature limitations and increasing steam plant efficiency. A one per cent increase in power output with no increase in over-all capital cost would be equivalent to a two and a half per cent reduction in the capital cost of the steam generating unit in the example given. One cannot expect large gains to be effected in this way because of the extensive metallurgical advances that must be made before appreciable increases in temperature can be tolerated. But even as steam temperatures have increased in conventionally fueled plants over the past twenty-five years, so it seems not unreasonable to expect that continued improvements in atomic plant efficiency will similarly serve to reduce the cost of generating electricity from nuclear fuels.

Unfortunately, an analysis of this type is too general to afford specific conclusions regarding the economics of atomic power. Nevertheless, trends can be discerned and discussed with particular reference to each reactor type.

In the pressurized water reactor, the principal developmental item influencing capital costs is the investigation of alternate construction materials. Stainless steels are used for most of the primary component equipment today; but if it becomes evident from experience that carbon steels can be so used, substantial reductions in cost could result.

The boiling water reactor's major developmental problem concerns the connection of the steam plant to the turbine-generator. This problem is ramified by the requirements for controlling the reactor and keeping contamination in the turbine plant at a low level so that maintenance procedures can be simple. A satisfactory solution to this problem could markedly reduce the capital cost of this reactor. Moreover,

the steam pressure and temperature for these first reactors have been chosen conservatively, and experience may show that they can safely be increased and more power extracted per unit volume, thereby effectively reducing the capital cost per unit power output. The extent of these reductions, however, cannot be evaluated until more experience is gained.

The sodium-graphite reactor as well as the fast breeder reactor has a high capital cost today, a result of the large number of precision-machined parts required for the reactor complex. Only experience will show where the demand for strict tolerances can be relaxed or techniques improved and costs decreased. Also, since both of these reactors employ a liquid metal heat transfer medium, it seems likely that steam temperatures could be increased without adding substantially to reactor costs. And although the temperatures are, at present, limited by fuel metallurgy, the characteristics of new fuel alloys appear to permit this increase. Accordingly, if continued development substantiates the presently meager data, power output per reactor could be increased, appreciably lowering capital cost per kilowatt. In fact, preliminary estimates for the sodium-graphite reactor indicate that increasing the temperature to that indicated by these early experiments would reduce the effective over-all capital cost by approximately twenty-five per cent. This is equivalent to a sixty per cent reduction in the steam generating unit cost, as computed in Table V. Since it is greater than the fifty-six per cent reduction necessary when using uranium-thorium, increasing the temperature would make this reactor competitive.

Two major developmental problems are contributing to the capital cost of the aqueous homogeneous reactor; the fabrication of large components with the required quality control using corrosion-resistant material, and the design requirements for complete remote maintenance of the major components. This latter item is more important in the homogeneous reactor than in any of the others because the circulating fuel seriously contaminates all of the major pieces of equipment. As a result, special precautions must be built into the plant to permit maintenance under quite unusual conditions. Were it not for this problem, the aqueous homogeneous reactor could have a relatively low capital cost.

In all of these reactor types, the fabrication of new metals in the sizes and shapes required is adding considerable cost. As soon as sufficient manufacturing facilities and techniques are established, it would seem probable that capital costs will begin to decrease.

OPERATING COSTS

Up to this point, only the reduction in capital costs has been discussed as a means of achieving competitive atomic power—and, of course, it is the most effective means to this end since capital charges constitute the major component of the price of generated electricity. Nevertheless, some marked reductions in the cost of atomic power may be achieved in the area of operating costs. From Table III, it may be observed that the important operating cost is the fuel operating charge, which is composed of three interrelated charges—fuel fabrication, reprocessing, and replacement

of burned or lost fuel. The factors influencing these costs are too numerous and complex to treat in detail here, but, in general, the following major approaches are being taken to minimize them:

1. Judicious nuclear design using special fuel alloys which minimize radiation damage can lengthen the time that each fuel element can stay in the reactor, thus reducing annual charges for fuel fabrication and reprocessing.
2. Continued modification of fuel element design so that mass production techniques can be utilized to reduce fuel fabrication costs.
3. Careful selection of fuel alloy materials and reprocessing techniques which are compatible can reduce the number and cost of the steps necessary to separate the fission produces from the fuel.
4. Continued investigation of the properties and characteristics of fuel in liquid form could lead to the elimination of the need for metallurgical fabrication and make reprocessing a simpler operation.

Relating these approaches to the specific reactor types being discussed, it appears that in the pressurized water and boiling water reactors, the problem is essentially the same. The relative incompatibility of water and uranium has forced the designers to use fuel alloys which are more difficult to fabricate and reprocess. Further, costs are high because of the inability to recover the waste material from the fabrication operation in an economical manner. Processes and techniques to reduce the amount of waste or to recover it economically would, thus, result in decreasing the fuel operating charges. Also, the use of thorium as a fertile material in these fuel elements would markedly extend the length of time that an element could stay in the reactor. Metallurgical problems, however, must be overcome before the combination of thorium-uranium will be an economic fuel element. Satisfactory solutions to these problems could, however, reduce fuel operating costs in these reactor types by a factor of two or more.

In the sodium-graphite reactor, the problems are similar, although the compatibility of sodium and uranium is better than that of uranium and water. This characteristic could lead to the development of a fuel element that might still have a long life, but be somewhat easier to process. Fabrication costs are still quite high, however, and the presence of sodium, which reacts violently with water, further increases handling costs when aqueous processing is used. An alternate type of processing and modified fabrication techniques may reduce this fuel operating cost.

The peculiar characteristics of a fast breeder reactor require that a larger amount of fissionable material be processed than would need be for the same power output in a thermal reactor. Accordingly, fuel operating costs will be relatively high until an alternate to aqueous processing is developed. Pyrometallurgical processing seems to afford a solution, provided it can be operated remotely with sufficient control. Successful development of a process of this type could reduce the fuel operating charge for a fast breeder reactor, to a fraction of today's estimates.

The aqueous homogeneous reactor promises lower fuel operating costs than any of the other reactors discussed. The fuel is in a convenient form for handling and needs no metallurgical fabrication. Changes in the chemical form will need to be effected, however, and these operations, though well-known, become somewhat costly when they must be done by remote means. Continued improvement in the process techniques may lower fuel operating costs of this reactor, but the reduction will probably not be as marked as in the solid fuel reactor types, as these costs are already estimated to be comparatively low.

III

During this interim period in the history of atomic power development, any discussion of costs necessitates a number of intuitive or educated guesses. To sort out the multitudinous factors influencing costs is almost an analytic impossibility. It is encouraging, however, that the price tags being placed on the first atomic power plants being commercially produced bring the electrical production charges to a level almost competitive with fossil fuels. It would seem that as a multiplicity of similar plants are built and operating techniques improved, nuclear fuels will achieve a competitive position with fossil fuels—especially in those areas where fossil fuel costs are high.

Besides the reactor types discussed, recent announcements by the AEC seem to indicate that two other design approaches are also reaching the stage where commercial development may become feasible. These are the liquid metal homogeneous reactor and the organic moderated reactor. To date, however, there has been no prototype experience with either, and, accordingly, the economics of their operation is still quite vague. But preliminary studies would seem to indicate that the technological improvements which have led to their development may also be reflected in economic improvements.

The acid test for any atomic power plant is actual operating experience. Therefore, until these first commercial plants are installed and operated for a reasonable period of time, no one will know to what extent design modifications are feasible or how the various economic factors influence the actual costs. That private industry is willing to share with the AEC a large part of the developmental costs of these first plants, however, would seem strongly to indicate that competitive atomic power is not far ahead.

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THE CHANGING ROLE OF THE ATOMIC ENERGY COMMISSION IN ATOMIC POWER DEVELOPMENT

ROBERT M. NORTHROP*

Peacetime atomic energy is truly a twentieth-century frontier. It has all the promise, the excitement, and the unexpectedness of the frontiers that spurred the imagination in eras past. Among the many uses of the peaceful atom, the generation of electric power from nuclear fission (and perhaps fusion) is probably the most far-reaching and significant. It may well have an utterly fundamental impact on the economic and social well-being of the peoples of the world. In the words of President Eisenhower, ". . . the atom stands ready to become man's obedient, tireless servant, if man will only allow it."[1]

At the beginning, more than a decade ago, America jumped into the lead in atomic energy development. Nuclear energy leveled two cities in 1945; since then, its destructive power has been vastly refined and often demonstrated, but never unleashed against human beings as it was at Hiroshima and Nagasaki. The achievement of the A-bomb required an incredible expenditure in men and resources and a necessarily exclusive concentration on destruction. At the war's end, peacetime nuclear power generation was little more than an intriguing possibility in the minds of a few scientists, who had been able to give it only limited attention during the big wartime effort. In the decade that has passed since World War II, however, the peacetime atom has slowly gathered the momentum that now promises to carry it on to provide almost unimaginable benefits for the entire world.

In this country, the influence of the United States Atomic Energy Commission, until recently, has blanketed the whole realm of atomic energy. It was a necessary decision in 1946 that kept atomic energy under the complete control of the federal government, where it had developed. The atom remained a governmental monopoly, and the AEC, directly responsible for its development and use, has been the overwhelmingly dominant locus of power in this field, together with the unusually influential Joint Committee on Atomic Energy.

Today there is a trend away from this unique domination by the federal government in the civilian phases of atomic energy. There is under way a program to create a true private atomic power industry under policies agreed upon by all branches of the Government and written into the new Atomic Energy Act of 1954.[2] This

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[1] N.Y. Times, Aug. 9, 1955, p. 8, col. 4.

[2] 68 STAT. 921, 42 U.S.C.A. §§2011-281 (Supp. 1954).

has had a substantial impact on the role of the Commission, for so long the exclusive steward of the atom. Government monopoly is giving way to ever more private participation in nuclear power. The Commission is performing new functions and facing new problems as it moves from its old operating role into the period of transition, marked by government-industry cooperative ventures, that will precede the advent of a private atomic power industry.

THE EARLY REACTOR PROGRAM

The early exclusive role of the AEC in atomic power development was carried out under the provisions of the original Atomic Energy Act of 1946.[3] The AEC was an operating agency in charge of a federally owned enterprise. According to the act, only the Government *could* own both fissionable materials and utilization facilities—reactors and weapons.[4] Work in atomic energy, therefore, had to be a program of the Government. This is not to say that other groups and individuals—especially scientists and industrial contractors hired by the AEC—had no influence on the program. It simply meant that the Commission was the only means of access to atomic energy. If there was to be atomic power development, it would have to be done through the AEC.

What, in fact, did the AEC do about atomic power? The possibility of producing power through nuclear fission was seen before the close of World War II. From the Manhattan Engineer District, the AEC inherited a rather rudimentary program of research aimed at solving the fundamental technological problems standing in the way of workable atomic power plants.[5] Dr. Farrington Daniels, of the University of Wisconsin, had made preliminary studies of power "piles," beginning in 1944 at Oak Ridge, and he had demonstrated their theoretical feasibility. Investigations of anticipated problems were carried on subsequently, and in 1946, this research program was divided between the Clinton Laboratories, at Oak Ridge, and the Argonne National Laboratory, near Chicago.

The MED had also awarded two prime contracts for power development. One, to Monsanto Chemical Company, was for development at Oak Ridge of a reactor based on the Daniels findings and on later research. The other contract, to General Electric, provided for research and development work on several different designs. The government-owned Knolls Atomic Power Laboratory, near Schenectady, New York, was established in November 1946 to facilitate this program.

Here, then, was a small but going program which the AEC took over from the MED. But even the feasibility of nuclear power was not yet assured. The range of difficult problems to be solved was enormous, and the effort required was a long, difficult, and costly one. Cheap nuclear power seemed hardly on the horizon in 1946.

[3] 60 STAT. 755, 42 U.S.C. §§1801-19 (1946).

[4] §§4(c)(1), 5 (a)(2), 60 STAT. 759, 760, 42 U.S.C. §§1804(c)(1), 1805(a)(2) (1946).

[5] The Manhattan Engineer District program is described in a 1946 press release reprinted in Joint Committee on Atomic Energy, *Atomic Power and Private Enterprise*, 82d Cong., 2d Sess. 174-78 (1952).

The AEC, when it took over the project, faced the problem which faces any agency: to balance the benefits to be derived from one program against those of other programs upon which the same money and effort might be expended. This question of priorities faced the Commission at once, and the answer was a foregone conclusion. Atomic power in the United States was not immediately necessary, since other sources offered plentiful power for the time being. Broad and energetic weapons and production programs, however, seemed extremely urgent, to say the least. The incoming Commissioners found that these programs were far weaker than had been expected, and the weapons and materials stockpile was surprisingly small. Scientific and technical personnel were leaving the project at the conclusion of the war, just when they were needed to push ahead with weapons development and to solve certain technical difficulties that had arisen—such as those threatening to shut down the plutonium-producing reactors at Hanford.[6]

To concentrate on these primary jobs, the AEC put atomic power development at a low priority. Some attention was given, it is true, to other peacetime uses, such as radioactive isotopes. But isotopes could be easily and quickly produced in the already-existing experimental "piles," and the usefulness to medicine and industry of cheaply produced isotopes was great. Atomic power, on the other hand, was speculative, uncertain, and obviously expensive and difficult. There seemed to be no justification for undertaking such a major effort at that time.

For these reasons, reactor development under the AEC was, for almost two years, a relatively minor program. The Commission, in carrying on the small MED program, did achieve some measure of progress. Some of the results were disappointing, however: Oak Ridge completed its studies of a gas-cooled reactor in late 1947, but the AEC, on the basis of these studies, decided not to proceed with what had turned out to be an unpromising design.[7]

The desire of the armed forces for military propulsion power reactors, however, did much to invigorate the Commission's reactor development program. The program, of course, was in such early stages that one could not easily divide it into military and civilian phases. Many technical problems had to be solved which applied to power reactors generally, regardless of their ultimate use. But there was military interest from early days, watching for developments that could be of use in warfare.

Particular impetus came from the Navy. Even before 1947, naval circles were planning to make eventual use of power reactors for aircraft and ship or submarine propulsion.[8] After some earlier consideration, the Navy commenced studies of a reactor and began to acquire data on the problems connected with it. In 1947, to get further data on heat transfer, the Navy negotiated a large research con-

[6] See *Hearings before the Joint Committee on Atomic Energy on Investigation into the United States Atomic Energy Project*, 81st Cong., 1st Sess., pt. 19, at 770-77 (1949).

[7] See *Atomic Power and Private Enterprise*, *supra* note 5, at 204.

[8] See *id.* at 203-06, for the story of early navy interest in nuclear propulsion.

tract with General Electric, and the AEC agreed to spend a smaller sum on naval reactor studies. After completing studies of the gas-cooled reactor, Oak Ridge began investigating a water-cooled reactor for a submarine at the Navy's suggestion.

During December 1947, the whole atomic power program was reviewed by the Navy, and specific recommendations were made to the Secretary of the Navy for working with the AEC on a submarine propulsion plant. The Secretary approved the plan, and proposals for a joint AEC-Navy program were forwarded to the Commission. Following a General Advisory Committee recommendation in favor of such a program, the AEC proceeded with planning. In late 1948, the Commission engaged Westinghouse to construct an experimental propulsion reactor in cooperation with the Argonne Laboratory.

When the AEC came into being, there was also a program for study of nuclear energy for the propulsion of aircraft, the NEPA project.[9] This study program, which was under neither the MED nor the AEC, was a combined operation of ten aviation companies and the National Advisory Committee on Aeronautics, working with the Fairchild Engine and Airplane Corporation, prime contractor under the Army Air Forces. The project received assistance from the AEC at Oak Ridge, and later carried out certain materials tests at the Commission's Idaho reactor testing station.

The year 1949 saw a considerable firming up of the reactor development program, in part due to this military interest. The Commission formalized its several projects into a combined military-civilian program. Its first step was the creation, in late 1948, of a new Reactor Development Division, partly on the recommendations of the Industrial Advisory Committee.[10] Early in 1949, the Commission activated the division by the appointment of Dr. Lawrence R. Hafstad as its director.[11] Soon afterward came the announcement of a new attack on the problems of reactor development, built around four types of military and civilian reactors: the navy thermal reactor for submarine propulsion, a fast breeder reactor, an intermediate breeder reactor, and a materials-testing reactor.[12] Commissioner Bacher, who revealed the new program, said also that attention was being given to other possible reactors, including aircraft propulsion plants and natural uranium and homogeneous power reactors.

However, the civilian power reactors were not projected primarily to develop power, but to develop the breeding process. This was felt to be important as a possible means of increasing the supply of fissionable materials for military uses. But even the breeder program was too long-range and speculative to withstand the intensification of the international atomic arms race following the first Soviet atomic explosion

[9] See *id.* at 178-79.

[10] See Atomic Energy Commission Names Carleton Shugg Deputy General Manager, Realines Duties of Headquarters Staff Divisions, AEC Release No. 122, Aug. 5, 1948.

[11] See United States AEC Names Dr. Lawrence R. Hafstad Director of Reactor Development Division, AEC Release No. 152, Jan. 16, 1949.

[12] See *Atomic Power and Private Enterprise*, *supra* note 5, at 252-54.

in September 1949. This event led to even more stress on the military side of reactor development and some slackening of work on the program for breeder power plants. Thus, in April 1950, the intermediate power breeder being developed by the General Electric Company at Knolls was cancelled. And, faced with a manpower shortage occasioned by the expansion in production at Hanford, which it operated, and the speed-up required on the military projects, General Electric was further compelled to curtail plans it had begun for a closely related intermediate reactor for naval propulsion.[13]

Thus, while the military uses of nuclear power invigorated reactor development, they also held activity away from civilian power projects. Later years saw continued emphasis on atomic military strength, both in expanded production and weapons programs and in the military reactor program. The latter, however, helped in solving technological problems of peacetime power reactors. This was particularly true of the submarine thermal reactor, a pressurized water type, which was closely related to the needs of civilian central-station power plants. The close relationship is shown by the fact that the first large-scale AEC power plant and two of the first industrial proposals are of this general type, as will be seen later.

Throughout the entire period of the early reactor program, the Commission made and executed atomic power policy behind the same barricade of secrecy that hid its weapons programs from the eyes of potential enemies. A few outside groups, it is true, did have access to the restricted realm of the atom, and these had an influence on the program. At first, the General Advisory Committee was extremely important in almost all phases of the AEC's activity. Beginning in 1949, under the energetic leadership of Senator Brien McMahon, the Joint Committee on Atomic Energy began to come into its own as a close participant in atomic policy formulation. The Industrial Advisory Committee had access through 1948 to the Commission's programs and made a number of helpful suggestions for improvement. And, of course, the AEC's few contractors had knowledge of the programs and a certain amount of influence. Even taken together, however, these groups made up an extremely small control group. It was still true that the Commission pursued its programs in relative isolation, and there was little outside control, participation, or criticism.

In 1951, however, the AEC began a trend in atomic power development toward ever greater knowledge and assumption of responsibility by private industry. Its new program of industrial participation marked the beginning of the end of the Commission's comparatively exclusive role in atomic power development.

INDUSTRIAL STUDY GROUPS

It was the needs of the military, so prominent in the early years, that gave rise to the Commission's industrial participation program, begun in 1951. This program grew out of a proposal by Dr. Charles A. Thomas, President of Monsanto Chemical

[13] See *id.* at 276.

Company. Dr. Thomas wrote to the AEC on June 20, 1950, and suggested a plan whereby ". . . American industry would design, construct, and operate one or more atomic power plants with its own capital."[14] According to the plan, the Government would own all fissionable materials. The plants were to be dual-purpose, producing plutonium as well as power. All plutonium would belong to the Government, which was to pay a fee for the production of this fissionable material. Such a fee would offset the high power costs and make the venture profitable for industry, it was felt. On the other hand, the Government would get plutonium at costs lower than those at Hanford, and the national security would be enhanced by increased and more widely dispersed plutonium production facilities.

In later discussions, Dr. Thomas suggested that this plan required three stages: a study of the AEC reactor program, development and design work, and construction and operation of the reactor.[15] In December 1950, Detroit Edison and Dow Chemical proposed an economic design survey of possible power reactors, which also required access to the AEC's information and know-how as a first stage.[16]

These two proposals favorably impressed the Commission. Early in 1951, the AEC announced its willingness to move ahead with the first step in each proposal: a study of the AEC reactor development program by properly qualified and cleared groups from the industrial concerns involved.[17] In May 1951, the Commission revealed that negotiations were nearly completed with four groups from industry for the commencement of these study programs.[18] In addition to the two original groups—Monsanto Chemical-Union Electric and Detroit Edison-Dow Chemical—two new groups entered the program: Commonwealth Edison-Public Service of Northern Illinois, and Pacific Gas and Electric-Bechtel. The AEC felt that no further proposals could be considered at the time because of the demands these studies would make on AEC technical personnel.

By April 1952, interim reports from all four study groups had been submitted to the Commission. The groups manifested a ". . . cautious optimism that the difficult technical and cost factors involved will be solved eventually."[19] The Dow-Detroit Edison group was the first to submit a proposal for going on to the next stage, which included additional research and development work by both the companies and the AEC. Others followed, and a second round of studies finally materialized. Five groups of companies participated—the original four and Foster Wheeler-Pioneer Service-Diamond Alkali.

In late 1953, the program underwent rapid expansion.[20] By the spring of 1955,

[14] See *id.* at 279.
[15] See *id.* at 297-98.
[16] See *id.* at 296-97.
[17] See *id.* at 297-301.
[18] See Atomic Energy Commission Will Consider Maximum of Four Industrial Reactor Studies, AEC Release No. 373, May 16, 1951.
[19] See AEC Accepts Dow-Detroit Edison Proposal for Continuation of Nuclear Power Production Study, AEC Release No. 422, April 22, 1952.
[20] See UNITED STATES ATOMIC ENERGY COMMISSION, NUCLEAR POWER REACTORS 1-5 (1955).

nineteen groups had participated, and eighteen were actively engaged under then-current study agreements. Some seventy-one companies made up the study groups. By 1955, several had progressed beyond the initial familiarization stage to undertake plant design and component developmental projects, such as fuel-element tests and heat-exchanger work.[21]

The early industrial participation program was important, not because it resulted itself in any marked alteration in the AEC's role in nuclear power development, but because it laid the groundwork for a new commission role in the period to follow. First, it advanced the technology to a substantial degree. By mid-1954, the AEC reported, the members of the study groups had spent almost five million dollars of their own money on developmental projects.[22] Second, it gave a number of industrial firms and public-power groups knowledge about nuclear power, without which their participation in future stages of development was naturally impossible. As a result of the study programs, according to the Commission, ". . . probably half of the [nineteen] groups have acquired sufficient know-how to be potential builders or operators of nuclear power plants."[23] In 1955, eight participants were able to bid on the army package-power reactor. And three members of the group, it was announced, had reached the point where they could undertake design and development programs as a start toward assuming the responsibility for technological advance that had previously been solely the Government's.[24]

Evolution of Policy for the "Induction" Phase

The first round of studies under the industrial participation program brought forth varying recommendations from the participants, but all were optimistic about the possibility of developing low-cost nuclear power. Meanwhile, the AEC itself had taken a step forward; at the end of 1951, it succeeded in producing small amounts of power from its experimental breeder reactor at the Idaho reactor testing station.[25]

The possibilities for future competitive nuclear power generation, then, seemed bright in 1952. It remained to attack the unsolved materials, design, and engineering problems. This meant partly that the research and testing of the past would have to be continued. It also meant that, before long, there would have to be construction of actual nuclear power plants, uneconomical though they would be. Only in this way, it was felt, could the final stages of development be carried out, to achieve power so cheap that it would compete with power generated by conventional fuels. Thus, by 1952, atomic power was moving from the earliest stage of basic research and feasibility studies into the second stage of active developmental work, including

[21] *Ibid.*

[22] See *Hearings before the Joint Committee on Atomic Energy on Development, Growth, and State of the Atomic Energy Industry*, 84th Cong., 1st Sess., pt. 1, at 12 (1955).

[23] See *id.* at 11.

[24] *Ibid.*

[25] See Experiment in Generating Power Successful, AEC Release No. 407, Dec. 29, 1951.

actual construction and subsequent refinement of the first full-scale "model-T" power plants.

The need for construction of actual power plants became more and more apparent as laboratory and small pilot-plant research and development began to reach the limit of its usefulness in advancing toward competitive nuclear power. Dr. Lawrence R. Hafstad, head of the AEC's Reactor Development Division, told the Joint Committee in mid-1953 that a stage of technology had been reached at which a number of different designs looked good.[26] It was impossible to tell which particular design would be the "winner" merely by making paper studies and analyses, however. Thus, a number of the best designs had to be built and operated, Dr. Hafstad said, in order to continue progressing toward cheap nuclear power. Chairman Dean elaborated on this by describing the four or five years after 1953 as a development period, which would be characterized by the building of reactor prototypes or experimental reactors.[27] These would be neither large enough nor sufficiently refined technically to produce economical power, atlhough they would produce rather substantial amounts of high-cost power, as compared with the previous experimental reactors. It is this developmental period that is referred to as the "induction" phase.

This period posed new issues for the AEC. Early research was, naturally, a commission monopoly. Early industrial study agreements had been able, in most cases, to do little more than provide access to industrial firms to observe the AEC's achievements in this field and to consider the possibility and direction of future efforts. By 1952, however, a number of industrial firms had developed sufficient know-how to become active in the later stages of development. How much of a role was private industry to have in this later work? Who was to build the experimental plants necessary to make nuclear power competitive?

The history of the Commission prior to this time indicates a basic philosophy, often stated, of allowing as much opportunity as possible for private groups—primarily business organizations and universities—to participate in the operation of the atomic energy project. The Commission of 1951 and 1952 continued to assert that private organizations must play a maximum role. In a speech delivered on November 29, 1951, Commissioner Glennan expressed concern over ". . . the overlong continuation of the present governmentally dominated industrial-governmental relationship for the prosecution of the atomic program. . . ."[28] He indicated to his audience of engineers some of the ways in which the AEC had attempted to enlarge the amount of industrial participation and urged them to be alert and aggressive in assuming a share of responsibility for atomic development.

At this same time, there were growing signs that industry was eager to assume this

[26] See *Hearings before the Joint Committee on Atomic Energy on Atomic Power Development and Private Enterprise*, 83d Cong., 1st Sess. 22-23 (1953).

[27] See *id.* at 24.

[28] See *Atomic Power and Private Enterprise*, *supra* note 5, at 316.

share of responsibility. During 1952, some eight different plans for building the first large noncompetitive plants were put forth by various groups inside and outside Government.[29] These proposals included several different patterns of government and private participation. Some persons thought the AEC should build new production reactors (or adapt those then under construction) to produce power as well as plutonium. By this route, the Government would bear the financial burden of developing reactor technology. This "all-Government" approach contrasted with other suggestions, including those of Detroit Edison, whose president, Walker L. Cisler, suggested that cooperative government-industry research should continue to iron out the problems for a time; then, subject to appropriate revisions in the law, private industry would itself finance and build a full-scale power-plutonium reactor. Several additional proposals contained still other possible arrangements for achieving the early stages of construction and operation.

Late in 1952, the Joint Committee on Atomic Energy determined that the time had come to make whatever basic decisions were required, including amendment of the act, if necessary, to dispel the uncertainty surrounding nuclear power and to get forward with the actual work. Therefore, the Joint Committee requested a policy statement from the AEC and scheduled hearings on atomic power development for the spring of 1953.[30]

The AEC policy statement received National Security Council approval before it was forwarded to the Joint Committee. It began with these basic points:

1) Development of economically competitive nuclear power is increasingly important both to the national economy and to the maintenance of American world leadership, and it must be carried out with all possible speed.

2) The Commission must continue an active program of research and development, but outside participation by qualified and interested groups is necessary to achieve maximum progress.

3) Reasonable incentives are necessary to encourage such outside participation. The Commission recommended several specific changes in the law which it felt would provide for the necessary incentives.[31]

As to the first point, foreign policy and international considerations had made it urgent to get forward as fast as possible in atomic power development. In May 1953, the National Security Council had determined that early development of cheap nuclear power was necessary to maintain our lead in atomic energy, and the Commission came to feel a compelling responsibility to achieve this important national objective. Achievements in atomic power abroad made it seem vitally important that the United States not be outdone in this field by other nations. Hence, the need for taking the shortest possible route with all dispatch.

To reach this important goal, the Commission contemplated a government pro-

[29] See *id.* at 19-26.
[30] See *id.* at iii-iv.
[31] See *Hearings, supra* note 26, at 6-7.

gram combined with increased private participation, stimulated both by revisions in the act (to give industry greater freedom) and by positive assistance from the AEC. In its statement, the Commission specifically ruled out, however, one of the incentives which had been extremely prominent in prior discussions. It was the objective of its policy, the AEC said, to further the development of nuclear plants which would be economically independent of government commitments to purchase weapons-grade plutonium.[82] Early consideration of industrial participation, it will be recalled, was mostly based on the dual-purpose idea, that private nuclear plants could be financed only by aid of a long-term AEC commitment to buy fissionable materials produced. As the Government's production program increased, the question arose whether the stockpile might not reach a point at which no more weapons were needed. It was seen to be difficult to assure a permanent market for these materials. Emphasis on materials production seemed likely to slow the advance toward power which was economically practical apart from subsidy through the purchase of materials.

In spite of its desire for eventual increased industrial participation, the AEC was convinced that it would have to do the early prototype building itself. At the hearings, Chairman Dean spoke as if several of the promising types of reactors would have to be pushed to the rather large prototype stage by the Government before private industry took over, and almost everyone agreed that at least one large industrial reactor would have to be government-built.[83]

The 1953 policy remained essentially unchanged during the next two years, while the new program for the transitional or "induction" stage crystallized. In 1954, the Commission restated its philosophy in basically the same terms.[84] In early 1955, the AEC philosophy had changed little, but the Commission assumed there would be more immediate assumption of industrial responsibility.[85] The program included advanced government research, plus industrial construction and operation (mainly without government assistance) of a number of early large-scale demonstration power plants.

This AEC philosophy is now being put into practice in a program which does, in fact, combine governmental research with the construction of large demonstration reactors, mostly financed by private industry. The year 1955 marked the beginning of the "induction" phase, wherein cooperative government-business activity is moving to build the first full-scale nuclear power plants, the necessary final step to a genuine atomic power industry.

Under the provisions of the new Atomic Energy Act, the Commission is assuming new roles as this phase of nuclear power development proceeds. From the preceding period, the AEC has continued its operating program. As the principal aspect

[82] See *id.* at 7.

[83] See *id.* at 24-25.

[84] See Joint Committee on Atomic Energy, *Report of the Subcommittee on Research and Development on the Five-Year Power Reactor Development Program*, 83d Cong., 2d Sess. 6-9 (1954).

[85] See Joint Committee on Atomic Energy, *Current Statement of the Atomic Energy Commission on the Five-Year Reactor Development Program*, 84th Cong., 1st Sess. 2-5 (1955).

of its activities at present, it is taking on a new role of aid and promotion, to achieve the agreed-upon policy of maximum private participation, including private ownership and operation of power reactors. In order that such scope may be given to industrial activity, the Commission must assume a third role, that of regulator of private operations in the interests of health and safety and the defense and security of the nation. This new regulatory role will loom larger as the atomic power industry becomes more firmly established and the other two roles diminish.

THE COMMISSION AS OPERATOR

Continuation of the Commission's own major research program did not require amendment of the act. At the close of the 1953 hearings, upon the request of Chairman Cole of the Joint Committee, the AEC began working out a governmental reactor program which contained those features which seemed most likely to advance the art toward competitive nuclear power and most appropriate for the Government, rather than private industry, to carry out. The result was the Commission's present Five-Year Reactor Development Program.[36]

The first element in the five-year program, the construction of a large-scale, pressurized water power plant for civilian use, was announced in October 1953.[37] Commissioner Murray, who first revealed this initial project, said the new central-station power plant would produce a minimum of 60,000 kilowatts of electricity.

Building the PWR, as this pressurized water reactor was called, was in keeping with the role the Commission felt it was necessary to play: construction mainly by government funds of at least one large prototype. It must be said, however, that the decision was precipitated by causes other than the advancing technology of the PWR. Another element in the picture was the world situation in 1953. It has been noted that the new Eisenhower administration was beginning to see peacetime atomic energy as an important pawn in world politics and the cold war. The Joint Committee and the AEC also held this view. The announcement, in October 1953, of Russian success in achieving a thermonuclear explosion intensified the feeling that atomic power policy was vitally important. Speaking for the AEC, Commissioner Murray said that an equally noteworthy achievement by the Russians in peacetime applications would be an even greater blow to the position and prestige of the United States among the world's nations than their success with the H-bomb. Mr. Murray expressed a strong conviction that maintenance of our leadership in the peaceful aspects of atomic energy is a goal of vital national importance.[38]

This combination of technical and policy considerations resulted in a decision that the time was at hand for prototype construction to begin. It was permitted by a provision in the fiscal year 1954 budget, inserted partly on the advice of the Joint Committee, which was pushing the Commission to take this step. Advancing technology had led the Commission to request funds to begin construction of experi-

[36] *Ibid.*
[37] See N.Y. Times, Oct. 23, 1953, p. 14, col. 3.
[38] *Ibid.*

mental reactors in its original fiscal year 1954 budget, the so-called "Truman budget," prepared by the outgoing administration. When the "Eisenhower budget" was prepared, however, the construction funds disappeared. Partly upon the urging of Chairman Cole of the Joint Committee, the House Appropriations Committee inserted language in the money bill recommending that not to exceed seven million dollars be spent to begin such construction. The need for international leadership in nuclear power resulted in the decision to build immediately a large-scale facility with this authorization, and it was on this understanding that the House Subcommittee voted the provision.[39]

In February 1954, the AEC revealed the remaining elements of its new five-year reactor development program.[40] This program was based on five approaches—out of "perhaps 80 or more"—to the problem of attaining competitive power. One was the large-scale PWR. The others were to be four small experimental reactors employing as many different principles of design: a boiling water reactor, a sodium-graphite reactor, a fast breeder reactor, and a homogeneous reactor.

Although this five-year development program was a government program, the Government alone, it was felt, could not bring to bear the same drive toward achieving maximum efficiency and lowest cost. Before going ahead on the PWR, Commissioner Murray said, the AEC had asked again the fundamental question: Would private industry, if permitted by law, do this job itself? By the close of the 1953 hearings, however, it had become clear that it was just "not in the cards" for industry to invest the necessary large sums of capital. The AEC did, however, attempt to give private industry the maximum possible role, particularly on the PWR. Commissioner Murray invited offers from industry to invest risk capital in the building of the steam and turbine portions of the plant, as well as in the operation of the entire installation.[41] This proposal created widespread interest in industry. Nine offers came from as many firms to share in the project. Of these, the one submitted by the Duquesne Light Company of Pittsburgh seemed most favorable to the Government, and was accepted in March 1954.[42] Duquesne offered to furnish a site for the project (at Shippingport, Pennsylvania), to build and operate the generating plant, to operate the reactor part of the plant, to assume five million dollars of the cost of research and construction, and to pay the Commission at a specified rate for the steam produced. AEC Chairman Lewis Strauss estimated at the time that this arrangement will reduce the Government's expenditures by thirty million dollars during the period of construction and the first five years of operation.

In the case of the sodium-graphite project, the AEC followed the precedent established with the PWR. The North American Aviation Company, which had

[39] See Statement of Sterling Cole, Joint Committee on Atomic Energy Release, Oct. 22, 1953. See also *Hearings before the Subcommittee of the House Committee on Appropriations on Independent Offices Appropriations for 1955*, 83d Cong., 2d Sess., pt. 3, at 2575 (1954).

[40] See *Report, supra* note 34, at 6-14.

[41] See N.Y. Times, Oct. 23, 1953, p. 14, col. 3.

[42] See AEC and Duquesne Light Co. to Negotiate on Atomic Power Plant, AEC Release No. 526, March 14, 1954.

worked on the sodium-graphite principle for some time, contracted to participate with the Government in joint development of the reactor.[43] North American agreed to assume two and a half million of the ten million dollar project costs and to furnish a reactor site.

THE COMMISSION AS PROMOTER

A. The Statutory Framework

Without amendment of the act, the AEC could hardly have achieved its second goal: primary industrial initiative in constructing additional large-scale demonstration reactors. Such amendment became a reality in August 1954, with the passage of a new Atomic Energy Act.

This greatly revised basic statute offered incentives to increased participation by industry in several ways. Most important, it permitted private ownership of reactors and private use of fissionable material (now called special nuclear material) under a system of licensing and continuing regulation.[44] It allowed patenting of inventions previously prohibited.[45] It authorized greater freedom in making available classified technical information to industry.[46] Finally, as will be seen, it permitted the Commission to offer additional incentive to private participation by granting various types of assistance during the developmental period.

The AEC did not, however, receive much guidance from the act on how to carry out this promotional role; consequently, it has a wide range of discretion. The first question is whether the AEC should offer assistance at all. Subsidy will probably not be a permanent feature in this area, because nuclear power is potentially cheaper than power from ordinary fuel sources. Government aid will not, then, be an indefinite support of a higher level of service than would otherwise occur. Once nuclear power is competitive, if not sooner, industry may be expected to invade the field with enthusiasm. How long aid will be necessary—and whether it will be necessary at all—is for the AEC to decide.

If the Commission decides promotion is necessary, it must resolve the issue of how to carry out this promotion. Several possible routes are provided in the act.

First, the AEC can offer assistance through its discretion in pricing. Since the Government owns all special nuclear material, it was decided that compensation should be given to private reactor owners who produce such material in their facilities. Whoever lawfully produces special nuclear material "shall be paid a fair price."[47] The act specifies the considerations which are to enter into the Commission's determination of a "fair" price. The Commission, says the act,[48]

[43] See AEC and North American Aviation Will Share Cost of Sodium-Graphite Reactor Experiment, AEC Release No. 550, July 13, 1954.

[44] §§41, 53, 68 STAT. 928, 930, 42 U.S.C.A. §§2061, 2073 (Supp. 1954); *cf.* note 4 *supra.*

[45] §152, 68 STAT. 944, 42 U.S.C.A. §2182 (Supp. 1954); *cf.* Atomic Energy Act of 1946, §11, 60 STAT. 768, 42 U.S.C. §1811 (1946).

[46] §§142, 143, 68 STAT. 941, 42 U.S.C.A. §§2162, 2163 (Supp. 1954); *cf.* Atomic Energy Act of 1946, §10, 60 STAT. 766, 42 U.S.C. §1810 (1946).

[47] §52, 68 STAT. 929, 42 U.S.C.A. §2072 (Supp. 1954).

[48] §56, 68 STAT. 931, 42 U.S.C.A. §2076 (Supp. 1954).

. . . shall take into consideration the value of the special nuclear material for its intended use by the United States and may give such weight to the actual cost of producing that material as the Commission finds to be equitable.

As the Joint Committee report explained, this means that the price is to be based "primarily" on the value to the Government of the intended use, and "only secondarily" on the actual production cost.[49]

This leaves a great deal within the discretion of the Commission. How does one determine the value of an atomic weapon, if it is decided that privately produced materials should be put to this use? Even if the question of value can be solved, do the words "primarily" and "secondarily" have any concrete meaning as used in the Committee report? The act itself is even more vague, stating only that the AEC shall "take into consideration" the one factor, and give such weight to the other as it deems to be "equitable." Even with the committee report, the Commission is hardly given any very specific guidance in setting these prices. Since the price schedules announced early in 1955 remain classified at the time of this writing, it is impossble to observe the manner in which the AEC worked them out.

The Commission also has wide discretion in setting prices for the use of special nuclear material and source material and for other materials and industrial services supplied by the Government. Special nuclear material and source materials may be distributed for use in research and development either without a charge or at a "reasonable charge."[50] The Commission must determine, in writing, criteria to judge whether or not a charge should be made. With special nuclear material, if a reasonable charge is found to be in order, the AEC still has room to set the prices at various levels. One factor to be considered is the cost of material to the AEC, but the use to be made of the material may also be considered, the extent to which that use will "advance the development of the peaceful uses of atomic energy," and the energy value of the material in the use to which it will be put. This allows wide individual adjustments. With source material, there is less opportunity for individual variation, but the AEC still is free to furnish the material without any charge at all, for private research and development.

As to other materials (*e.g.*, heavy water) and industrial services (*e.g.*, fuel-element fabrication and chemical processing), the Commission must set nondiscriminatory prices which provide "reasonable" compensation for the Government and which do not discourage the development of independent sources of supply.[51] However, under the provision of section 31,[52] permitting the AEC to make research and development contracts and other arrangements, it seems likely that the Commission can provide materials and services without any charge at all, although this problem

[49] See H. R. REP. No. 2181, JOINT COMMITTEE ON ATOMIC ENERGY, *Report to Accompany H.R. 9757, Amending the Atomic Energy Act of 1946*, 83d Cong., 2d Sess. 16 (1954).

[50] §§53(c), (d) and 63(c), 68 STAT. 930, 933, 42 U.S.C.A. §§2073(c), (d), and 2093(c) (Supp. 1954).

[51] §161(m), 68 STAT. 950, 42 U.S.C.A. §2201(m) (Supp. 1954).

[52] 68 STAT. 927, 42 U.S.C.A. §2051 (Supp. 1954).

of statutory interpretation has not yet been settled. In any case, the requirement of "reasonable" compensation for the Government is not a strict one and gives the AEC discretion to set prices which substantially aid the private firms involved.

In regard to "burn-up" or loss of special nuclear materials, the AEC is of the opinion that it has discretion under the act to decide whether to charge or not in connection with research and development projects. Section 53(d)(5) requires a charge under commercial licenses, but says nothing about section 104 licenses.[53] This the Commission interpreted to mean that "we are not required under section 104 to charge for burn-up, but we are not prohibited from doing so."[54]

Representatives Holifield and Price of the Joint Committee have pointed out and deplored the additional subsidy possibilities provided by these pricing provisions, over and above the built-in subsidy afforded by retaining government ownership of special nuclear materials and requiring that private producers be compensated.[55] Regarding the AEC's power to make a "reasonable charge" for use of materials and to pay a "fair price" for materials produced, they have stated:[56]

> But the vague generalities set up in lieu of standards to guide the Commission in determining both these critical figures leaves a degree of discretion in the administrative body that would enable it to pay considerably more for the production than it charged for the original supply of special nuclear material, thus affording private utilities, let us say, subsidies of undetermined magnitude for their participation in the development of nuclear power. Such subsidies resulting from dual transactions might well escape the public eye.

Second, the AEC can assist private endeavor in nuclear power research and development by "arrangements (including contracts, agreements, and loans) for the conduct of research and development activities relating to" a number of specified areas of atomic theory, production, and utilization.[57] The language of section 169 appears to permit this form of aid in connection with private nuclear power plants under noncommercial section 104 licenses.[58] As will be seen, this interpretation of the statutory language gave rise to a dispute, the outcome of which is not yet entirely clear.

B. A Concrete Program for Increased Industrial Participation

With a framework for augmented industrial participation established by the new statute, the Commission moved to take advantage of its potentialities. In January 1955, the classified price schedules were made available. A few days later, Chairman Strauss revealed the new AEC Power Demonstration Reactor Program,

[53] 68 STAT. 930, 42 U.S.C.A. §2073(d)(5) (Supp. 1954).
[54] See *Hearings*, *supra* note 22, pt. 1, at 180.
[55] §§52, 56, 68 STAT. 929, 931, 42 U.S.C.A. §§2072, 2076 (Supp. 1954).
[56] H. R. REP. No. 2181, *op. cit. supra* note 49, at 131.
[57] §31, 68 STAT. 927, 42 U.S.C.A. §2051 (Supp. 1954).
[58] 68 STAT. 952, 42 U.S.C.A. §2209 (Supp. 1954).

providing for private development, construction, and operation of large-scale power demonstration reactors, with some financial assistance from the AEC.[59]

The underlying philosophy of this new proposal represented, as noted, a slight advance over the original 1953 views. Although the Commission was to continue to push forward with its own experimental and research program, it appeared that further large prototype construction should be turned over mainly to industry. Without further large-scale construction by the Government, the AEC hoped that principal financial and technical responsibility would be accepted by industry in order to achieve economic nuclear power at the earliest possible date. However, the Commission was still convinced that governmental assistance was necessary.

While Congress wrote the new act, the AEC was already working out detailed plans to bring industry into atomic power to an unprecedented degree. The Commission's thinking was revealed in July 1954 by Dr. Hafstad.[60] He suggested that the incentives for industry to invest in large but uneconomical developmental reactors might be provided under a cooperative arrangement which he called a "reactor-of-the-year" program. Under this plan, utilities would substitute a few full-scale atomic reactors for conventional plants in the course of normal expansion. These would unquestionably cost more than conventional plants. The utilities would offer a sum more or less equal to the cost of a comparable, conventional plant at the same location, and the AEC, as part of its research and development expense, would make up the difference. If several such proposals could be developed each year, the one of minimum cost to the Government for the greatest technological advance would be accepted as the "reactor of the year." In addition, the Government would purchase by-product plutonium at a fair price.

Although the new act seemed to preclude the use of commission funds to aid the construction of private nuclear power plants, the Commission remained convinced that some federal aid was necessary. General Manager Nichols explained to the Joint Committee that, ". . . in our talks to various companies . . . none of them felt that the state of the art was yet ready where they could completely finance a research and development reactor of any reasonable size."[61]

Some members of the Joint Committee questioned this conclusion. Senator Anderson seemed unconvinced that it was wise to make an immediate offer of subsidy. "Why not try them first?" he suggested. "Then if nobody comes in and offers to put up his own money, then say, all right . . . we will go the subsidy route. I do not believe you ought to try that first."[62]

What sort of assistance did the Commission determine to be appropriate? One

[59] See AEC Announces Demonstration Program Opening Way for Industrial Power Reactor Development, AEC Release No. 589, Jan. 10, 1955.

[60] See Industrial Atomic Power and Its Relation to Development of Other Natural Resources, an address by Dr. Lawrence R. Hafstad before the Missouri Basin Inter-Agency Committee, AEC Release, July 21, 1954.

[61] See *Hearings*, *supra* note 22, pt. 1, at 157.

[62] See *id.* at 159.

form of aid it specifically ruled out: the price schedules indicated that it would be AEC policy not to assist private industry by rigging the secret prices charged and prices paid by the Government so as to give subsidies of a size known only by those with access to classified information. In regard to the payments for privately produced special nuclear material, the Commission put in its price schedule "certain incentives for weapon grade material" during the first seven year period but built the pricing structure essentially around the "fuel value" of the materials.[63] Moreover, the Commission decided to charge for fuel-element fabrication and the various chemical processing operations so as to recover full costs, thus placing the full burden of these operations on industry.[64] Finally, the Commission exercised its prerogative to charge for special nuclear material consumed or lost.[65] The act seemed to indicate, it will be recalled, that these last charges might have been waived.

What, then, was the form in which the AEC proposed to make assistance available to private industry? Under its Power Demonstration Reactor Program, announced at the same time as the price schedules, the makers of acceptable proposals for construction of large-scale demonstration power plants might receive one or more of three kinds of assistance:[66]

> . . . waiver of the charge that the licensee would otherwise have to pay for the use of special nuclear material or source material furnished by the AEC; performance in AEC laboratories and test facilities without charge to licensees of certain mutually agreed upon research and development work; and financial assistance under appropriate research and development contracts.

The first group of proposals to the AEC under the Power Demonstration Reactor Program was received by April 1, 1955, the deadline set by the Commission. (Assuming favorable and effective responses were made, Chairman Strauss had said, the AEC would establish subsequent dates for receiving additional proposals.) The initial proposals came from Yankee Atomic Electric in Massachusetts, Commonwealth Edison of Chicago and associates, Detroit Edison and associates, and the Consumers Public Power District in Nebraska.[67] The four proposals included four of the five types of reactors stressed by the Commission in its five-year development program—all except the homogeneous reactor. These projected facilities made up a total of almost 450,000 kilowatts of generating capacity.

Although its proposal was made under the demonstration program, Commonwealth Edison and associates, known as the Nuclear Power Group, did not ask for any of the types of assistance offered by the AEC. One other utility felt that it did not need such aid from the Commission. New York's Consolidated Edison Company applied for a straight license, at about this same time, to build a full-scale

[63] See *id.* at 75-76.
[64] *Ibid.*
[65] See *id.* at 74 and 180.
[66] See Release, *supra* note 59.
[67] See Four Proposals Made to AEC Under Power Demonstration Reactor Program, AEC Release No. 620, April 7, 1955.

nuclear plant at a site on the Hudson River near Peekskill, New York.[68] The power from this modified version of the Nautilus's pressurized-water reactor was calculated to serve the rapidly increasing power needs of Westchester County, New York. Capacity of the plant was projected at nearly 250,000 kilowatts; 140,000 kilowatts were to come from the nuclear portion and the rest from an oil-fired superheater arrangement.

By the end of August 1955, two additional proposals had been made. One was a project of the Pennsylvania Power and Light Company for a large-scale homogeneous reactor and power plant with a capacity of 150,000 kilowatts, to be located in eastern Pennsylvania.[69] This meant that all five of the most promising types had been proposed for large-scale private construction. The other plan came from the Rural Cooperative Power Association of Elk River, Minnesota, which suggested construction of a relatively small 22,000 kilowatt plant.[70]

Thus, by the early fall of 1955, the induction phase of nuclear power development appeared to be under way. It is true that in August, the AEC did reject two of the original demonstration proposals: those of Yankee Atomic Electric and the Consumers Public Power District. But it approved the other two—those of the Commonwealth Edison and Detroit Edison groups— as forming a satisfactory basis for negotiation, and in so doing, paved the way for the first large-scale, privately owned atomic power reactors.[71]

THE COMMISSION AS REGULATOR

The third function of the Atomic Energy Commission during the present transitional, or "induction," stage of atomic power development is regulation. In carrying on this activity, the Commission's transitional role merges with that of the later period of full-fledged atomic industry, when research and development are chiefly to be left to industry, when no promotion will be necessary to induce private firms to engage in what will have become a competitive source of power, and when the Commission will confine its activity in this field mostly to licensing and continuing supervision—that is, to regulatory functions similar to those exercised by the several existing so-called independent regulatory commissions of the federal government.

Those who are induced to enter the present "induction" phase of nuclear power

[68] *Ibid.* See also testimony of Consolidated Edison's president, H.R. Searing, *Hearings, supra* note 22, pt. 2, at 402-07.

[69] See N.Y. Times, Aug. 16, 1955, p. 7, col. 3.

[70] See *id.*, Aug. 9, 1955, p. 8, col. 2.

[71] See AEC Authorizes Action Toward New Nuclear Power Reactors, AEC Release No. 674, Aug. 8, 1955. Later, the AEC approved a revised version of the Consumers Public Power proposal as a basis for negotiations. See AEC Authorizes Reactor Power Plant Negotiations With Nebraska Public Power Group, AEC Release No. 723, Oct. 27, 1955.

In September 1955, the Commission initiated a second phase of the Power Demonstration Reactor Program by calling for new proposals from industry—this time, to build nuclear plants of less than 40,000 kilowatts capacity. The types of assistance offered were similar to those offered for the original proposals, although the Commission stated its willingness to finance and retain title to all or part of a reactor system as an additional means of aid. See AEC Invites Proposals for Small-Scale Experimental Nuclear Power Plants, AEC Release No. 695, Sept. 21, 1955.

development by the Commission's promotional program (or simply by the hope of getting a head start which will provide bigger ultimate profits) must operate under a strict control scheme established by the 1954 act. First, these firms must submit to the licensing provisions of the act. The primary license requirements are three in number: one who builds or owns a reactor must have a license; one who acquires, processes, or uses nuclear fuel—source material or special nuclear material—must have a license; and one who operates a nuclear reactor must have a license.[72] This system gives the Commission the opportunity to review in advance all proposed activities and decide whether and under what conditions they should be carried out. Second, private participants must submit to a system of subsequent control, which includes broad inspection and supervision, and the right, under certain circumstances, to suspend or revoke licenses, to order the operation of licensed facilities, or to recapture special nuclear material.[73]

The statute provides for two types of facility licenses, under sections 103 and 104.[74] The former are called commercial licenses; the latter, for medical therapy and research and development, may be called noncommercial. No commercial licenses may be issued until the AEC has made a finding in writing that some type of "utilization or production facility has been sufficiently developed to be of practical value for industrial or commercial purposes."[75] In regard to the licensing of noncommercial reactors under section 104—the only kind of facilities which will be built for some years—the Commission's discretion to grant or withhold a license is complete. The section is permissive; it simply authorizes the AEC to issue licenses for certain kinds of reactors under certain conditions.

The way in which the AEC controls development under section 104 may be gauged by extrapolation from the criteria used in the demonstration program. The Commission stated five criteria which would guide its consideration of whether to accept or reject the various proposals that might be made. Decisions were to be made on the basis of 1) the probable contribution of the proposal toward achieving competitive nuclear power; 2) the cost to the AEC; 3) the financial risk to be assumed by the maker of the proposal; 4) the competence and responsibility of the maker; and 5) the assurance given against abandonment of the project.[76] It is clear that the AEC intends to make sure that it has ample discretion in arranging for industrial participation. Action has already been taken on the original four proposals; the AEC, however, has given no indication (at the time of this writing) as to which of these criteria resulted in the approval of two proposals and the original rejection of two others.

These, then, are some of the more important aspects of the regulatory scheme

[72] §101, 68 STAT. 936, 42 U.S.C.A. §2131 (Supp. 1954).

[73] See HERBERT S. MARKS AND GEORGE F. TROWBRIDGE, FRAMEWORK FOR ATOMIC INDUSTRY 109-19 (1955).

[74] 68 STAT. 936, 937, 42 U.S.C.A. §§2133, 2134 (Supp. 1954).

[75] §102, 68 STAT. 936, 42 U.S.C.A. §2132 (Supp. 1954).

[76] See Release, *supra* note 59.

provided by the act. The Commission began to lay the groundwork for its regulatory activities soon after the passage of the Atomic Energy Act of 1954. It first issued two interim orders, one of which continued in effect, for the time being, all the then-existing regulations.[77] The Commission then undertook the extensive job of drawing up a new body of licensing regulations as required by the new legislation. By early 1955, the staff work had progressed to the point of submitting some of the draft regulations to the Commission for study. Over the next few months, these draft regulations in the various fields were published so as to make it possible for interested parties to inspect them and make any suggestions that seemed desirable before they became effective.[78]

For administrative purposes, the Commission, in 1955, established a new Division of Licensing, to be responsible for the preparation and administration of AEC regulations dealing with licensing of private atomic energy activities.[79] Within a short time, however, this was superseded by a Division of Civilian Application.[80] Its responsibilities include developing and issuing regulations and price schedules, licensing, handling requests for access to restricted data, authorizing distribution of source, special nuclear, by-product, and other materials, and authorizing production of special nuclear material outside the United States.

For purposes of inspection and supervision of licensed activities, the 1954 act established a statutory Inspection Division.[81] The AEC opposed this provision; the function is important, said the Commission, but it is a tool of management and should be flexible to allow administrators to adapt it to their particular needs.[82] However, Congress went ahead and inserted the provision in the law. Consequently, the Commission set up such a division, with the function of gathering information to show whether contractors, licensees, and officers and employees of the AEC are complying with the act's provisions and commission rules and regulations.

THE COMMISSION'S MULTIPLE ROLE

Three principal functions, then, make up the present multiple role of the AEC. This role has become increasingly complex as its newer aspects of promotion and regulation of private activities have come more into prominence. However, these commission functions are closely bound together during this period and require the utmost coordination. Both aspects of the present drive to develop civilian nuclear power—the five-year development program (operating) and the demonstration pro-

[77] See *Hearings, supra* note 22, pt. 1, at 56.

[78] See *id.* at 57-58. See also remarks of Charles G. Manly, of the AEC's Division of Civilian Application, presented before a Committee of the Machinery and Allied Products Institute, AEC Release, July 27, 1955.

[79] See Division of Licensing Established, Harold L. Price Named Its Director, AEC Release No. 615, March 30, 1955.

[80] See AEC Establishes Division of Civilian Application, Harold L. Price Named Director, AEC Release No. 656, June 29, 1955.

[81] §25(c), 68 STAT. 925, 42 U.S.C.A. §2035(c) (Supp. 1954). See also *Hearings, supra* note 22, pt. 1, at 221-22.

[82] See *Hearings before the Joint Committee on Atomic Energy on S. 3323 and H.R. 8862, to Amend the Atomic Energy Act of 1946*, 83d Cong., 2d Sess., pt. 2, at 605-06 (1954).

gram (promotional and regulatory)—are so closely related that they seem almost to merge. The tie-up between the two is indicated by two items in the AEC budget request for fiscal year 1956. In the operating expenses estimates, over and above the amounts for specific five-year development program items, the Commission asked for fifty million dollars for what it called the Power Reactor Acceleration Program. The national interest requires, said the Commission, that the 1954 plans for developing nuclear power be accelerated. Therefore, it was proposed to spend fifty million dollars to expand the "engineering development" on nuclear power reactors and to advance the time when nuclear power will become economically competitive. Of this sum, costs up to ten million dollars were to be incurred in fiscal year 1956, the rest to be obligated but unpaid.[83] Later, in the plant and equipment budget, the AEC asked for an additional twenty-five million dollars for 1956, making a total of seventy-five million dollars for this acceleration program.[84]

Before the Appropriations Committees, commission spokesmen were vague as to just how this money would be used. It developed that the money would not be limited to assisting industrial firms which were carrying out projects under the demonstration reactor program. According to the justifications, the plant and equipment sum was to be available for commission construction of reactors in which industry showed no interest, for construction of government facilities to carry out work required by "both the AEC and private power reactor program," for construction of testing or processing facilities needed because of advances in reactor or reactor component design, and for joint industry-government projects where the AEC might build and own a portion of the plant. The operating expenses item was also to be utilized both in connection with the proposals from industry and in order to accelerate the Commission's own projects.[85]

The AEC, throughout, asked for a maximum of flexibility on this item. Before the Joint Committee approved authorization of the twenty-five million dollars in capital funds, Representative Durham wanted the agency to suggest some formula specifying that a given percentage of cost would be allocated to industry and the rest to Government under the joint demonstration program phase. General Manager Fields indicated that this was impossible, that the AEC did not know just what sort of proposals would later be received, and that the percentage of contribution by each participant might vary widely. It might be necessary for the Government to support some promising types nearly 100 per cent, and others only 10 per cent.[86]

"What you are essentially asking for," said Representative Holifield, ". . . is a

[83] See *Hearings before the Subcommittee of the House Committee on Appropriations on H.R. 6766, Public Works Appropriations, 1956*, 84th Cong., 1st Sess. 391 (1955).

[84] See *Hearings before the Subcommittees of the House Committee on Appropriations on the Supplemental Appropriation Bill, 1956*, 84th Cong., 1st Sess. 985 (1955).

[85] *Id.* at 985-86.

[86] See *Hearings before the Subcommittee of the Joint Committee on Atomic Energy on Authorizing Legislation*, 84th Cong., 1st Sess. 13-14 (1955).

floating fund of twenty-five million dollars which, as the different reactor programs are developed, you may assign on the judgment of the Commission . . . as you feel will be necessary for each one of these reactor programs."[87] Commissioner Libby agreed that this was true.[88]

It was not unrealistic to assume that some of the more promising types of reactors might not be proposed by industry. The initial offers made by industry under the Power Demonstration Reactor Program did not include the homogeneous type, considered by the AEC to be perhaps the most promising of all in the long run. The Commission anticipated such a development and discussed it with the Joint Committee prior to receipt of the April 1 proposals. Representative Holifield strongly urged that the Government cannot just let this program lag. "If we do not get the proper kind of responses to the different types of reactors that seem feasible," he went on, ". . . the Government should go ahead with experimental work. . . . We cannot afford to be outdistanced in this field by foreign powers."[89]

Although Mr. Holifield was most insistent, the AEC and the Joint Committee seemed generally to share his feeling. Later, when the first proposals were all in, Commissioner Libby stated his surprise and disappointment that no one planned to build a large homogeneous reactor, and suggested that he would strongly favor governmental development and construction if no one took the initiative on this reactor type at the next submission of proposals.[90] This did not become necessary in the case of this particular type because of the later proposal by the Pennsylvania Power and Light Company. But it was by no means assured that the five reactor types stressed under both the five-year program and the demonstration program would ultimately prove to be the most fruitful designs. The AEC at this time (mid-1955) was working ahead on several additional reactor types which might, it seemed, turn out to be even more promising than the original five. In this case, the AEC will, doubtless, again stand ready to assume the initiative in large-scale construction if industry should fail to do so.

The over-all goal of maximum progress toward economic nuclear power, then, binds together the present governmental and private programs. It conditions the AEC's own efforts and the nature of the promotion to be carried on. The Commission must stimulate industrial participation not only for its own sake, but as a means of achieving competitive power most swiftly, as required by the need to keep in the forefront of world atomic energy development. In this joint operation, coordination and harmonization are necessary. This must be the task of the AEC.

TRANSITION TO THE REGULATORY PHASE

The present three-part role of the AEC in civilian atomic power is a transitory one. Later, the Commission's operating and promotional roles in the field will

[87] *Id.* at 13.
[88] *Ibid.*
[89] See *Hearings*, *supra* note 22, pt. 2, at 423.
[90] See *Hearings*, *supra* note 86, at 55.

presumably diminish as the atomic industry gets under way in earnest. Since the atom offers a potentially cheap source of power, there should be no need for permanent subsidization to maintain a high level of progress in constructing and perfecting nuclear plants. The Commission should be able to allow industry to handle most of the development work; thus, the principal duties that will fall to the AEC will be those of a regulatory nature.

This future period of full-scale atomic industry will involve section 103 licenses for construction and ownership by private firms of atomic power reactors. At first reading, the law seems to draw such a distinction between these and section 104 developmental licenses that the future period of regulation appears likely to be characterized by a lesser degree of control by the AEC and more freedom for private activity. However, when the language of the act is closely examined, one sees that it allows the Commission substantially as much discretion to grant or refuse licenses, and to control those granted, as under section 104.[91]

There has been some criticism of the 1954 act because of the strictness of the regulatory scheme set forth therein. It is an unusual field, and the requirements of security and safety are unusually great. Furthermore, there is, as yet, little experience with which to give meaning to some of the terminology and concepts used by Congress in setting forth and defining the procedures and policies to be followed by the AEC. If it seems that the agency's discretion is extremely broad, it is perhaps the result of the fact that experience in atomic power is so meager that it is now impossible to legislate in meaningful terms. Perhaps the several years of experience under section 104 which will precede the granting of any section 103 commercial licenses will be such as to give meaning to the standards and policies Congress incorporated in the act. If not, it may be that the law will have to be amended to clarify and specify in certain areas in order to leave the agency somewhat less free to take whatever course it feels is appropriate.

Whatever modifications may be made in the statutory framework supporting the regulatory functions of the Commission, the problem will remain of combining in one agency a substantial load of regulatory duties and an equally substantial operating program in the fields of production, weapons, research, and reactors for military propulsion. It is essentially the same organizational problem as that posed by the threefold combination of the present developmental period. The arguments for retaining all functions in one agency may be less compelling in this later stage; the traditional issue of the wisdom of combining regulation with the executive and operating activities will be more pertinent.

Most political scientists argue against such a combination, particularly in agencies headed by a group of commissioners. "The common experience is," said the first Hoover Commission's task force, "that groups are better fitted for judgment and

[91] See MARKS AND TROWBRIDGE, *op. cit. supra* note 73, at 82-85.

decision than for the execution of large-scale operations."[92] Furthermore, the task force continued, most regulatory commissions find that their purely regulatory duties are extremely time-consuming; not only are they not fitted for operating functions, but performance of these weakens their ability to perform their primary functions by taking time that should be devoted to regulatory duties. The task force suggested that operating functions should be placed in the regular departments as far as possible, so that they may be carried out under direct executive supervision and responsibility.

The problem, however, is not an immediate one, for it will arise only when the nuclear power industry becomes a reality. How long is the present transitional or "induction" stage likely to last? Although atomic energy has been one of the areas most productive of wrong predictions and inaccurate guesses about the future, even from the best informed, a few points are clear. One is that the first round of large-scale demonstration power plants will just be starting to operate by 1960, assuming that some of them can get under way soon. One cannot help thinking that the 1959 completion date set by Detroit Edison is over-optimistic. Even the PWR will not be completed until 1957. In any case, experience with these first plants, and perhaps with subsequent ones which may be begun in the next year or two, cannot be expected to be available before the early 1960's. One hesitates to predict the end of the induction stage before 1965. The AEC's Reactor Development Division head, W. Kenneth Davis, has said that the induction phase will probably end at about that date, although it may vary two or three years either way.[93] The end will be largely a psychological point, he has suggested, when confidence in the eventual advantages of nuclear power becomes so great that atomic plants form a large proportion of all new power plants. At this date, the problems will probably still not be solved, and no one will have generated nuclear power that actually is competitive.

It is easy to see that the AEC is not about to be overwhelmed with regulatory duties emanating directly from the generation of nuclear power. For at least a decade, the number of atomic power plants will probably be small. During that time, the AEC may be expected to continue in its operating-promotional-regulatory role, which forms the bridge to the atomic power industry of the future.

[92] COMMISSION ON ORGANIZATION OF THE EXECUTIVE BRANCH, TASK FORCE REPORT ON REGULATORY COMMISSIONS, APPENDIX N 30 (1949).

[93] See Nuclear Power Industry Development, an address by W. Kenneth Davis before the American Power Conference, AEC Release, April 1, 1955, p. 7.

DEMOCRATIC CONTROL OF ATOMIC POWER DEVELOPMENT

MORGAN THOMAS*

Atomic power is a new source of energy which complements the older power sources found in coal, oil, and natural gas. Although it involves a technology developed and held in restricted form by the Government, it is filled with industrial potential for the national welfare and for the nation's business. Important for these reasons, it is placed on the battleground where American public policy is formulated.

Both domestic and foreign policy are concerned with progress in making nuclear power a practical, economic reality. Domestically, it has a great potential effect on the economic balance of forces. Internationally, it has the characteristic of a much desired body of new knowledge and new techniques which major powers can take to underdeveloped nations in return for their friendship and support. Hence, atomic power cuts into the conflict of contending forces at odds over governmental policies. It catches up the political partisans and gains their artful attention and publicizing. In short, an open struggle of the American system of democratic control is emerging, with all the trappings of pressure groups, partisan forces in Congress and the Executive Branch, and frequent treatment by opinion-leaders, such as commentators, prominent businessmen, editorial writers, and national news magazines. A lively subject for "issues" is moving into prominence on the American stage of public policy-making.

The highly charged political characteristics of atomic power contrast rather sharply with the general low level of political involvement to which the field of atomic energy has previously been subjected. Atomic energy policy has been defense policy, largely formulated in secret within government councils of officials and security-cleared advisors. From time to time, some questions have spilled out into the public domain. One was the security policy of the Lilienthal Commission, as seen in the so-called Hickenlooper inquiry—the investigation of the AEC in 1949 by the Joint Committee on Atomic Energy. Another was the decision to go ahead with an H-bomb "crash" program. However, it was made public only as limited, after-the-fact information. Some other important decisions, too, were kept completely hidden from the public when made—*e.g.*, the addition of production reactors and heavy water manufacturing plants at Savannah River and the establishment of a new experimental weapons laboratory at Livermore, California. And the public learned of the decision to enter upon a tremendous expansion of gaseous

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diffusion plants only through the involvement of the congressional appropriations committees in the summer of 1952. Therefore, on the whole, no active outside groups took stands, no commentators presented conflicting views, and democratic control over the Atomic Energy Commission came largely from commission advisers, from members of the Joint Committee on Atomic Energy, and, on some issues, from the President and his immediate staff.

Over all, the defense nature of the program facilitated fairly unanimous resolution of small differences. Occasionally, disputes within the "inner control groups," behind the cloak of secrecy, did manifest themselves, but they were not of long duration. For example, President Eisenhower eliminated the prototype of an aircraft carrier reactor from the budget estimates in the spring of 1953, but, on the instigation of the Joint Committee on Atomic Energy, and with the help of the appropriations committees, the item was converted into a large-scale prototype of a central-station power plant which the AEC was encouraged to start. Thus, policy was worked out by a governmental control group. It served, to be sure, as an instrument of public control, but it was not held accountable by the support or opposition of outside groups or forces. The political representatives who made up the control group recognized their responsibility to test the atomic energy program by their own interpretation of what would best serve the nation, but there was no real democratic check on this interpretation.[1]

Today, however, atomic power is ushering in a new set of conditions for public control. As the immediate concern of pressure groups, it enters an area where two entrenched and bitter opponents, public-power advocates and private-power advocates, fight with all the available political weapons. Furthermore, as the day dawns when private participation in atomic power begins and chances for private profit appear on the horizon, forces of self-interest are unleashed. Thus, the different businesses affected, such as the electric power, chemical engineering, and electric equipment manufacturing industries, see their rival and complementary positions in alternative schemes for development of atomic power. The forces of private initiative bring their inevitable concomitants, those of monopoly and favoritism. And the individuals and groups in our society who worry about these forces enter the fray. The Government's vast investment provides a source from which insiders and especially advantaged firms can benefit at the cost of others. The charge of "give-away" is heard. The manifestations of democratic political control have come on the scene.

The emergence of many aspects of democratic public control does not mean, however, that the technical information necessary for work in the field of atomic power has been wholly declassified. The reason for this is that the Government's program of research and development in reactors is a combined military-civilian program. The same reactor technology applies to the military field as to the civilian. Military

[1] For a general and more extended discussion of the foregoing, see MORGAN THOMAS, ATOMIC ENERGY AND CONGRESS (to be published by the University of Michigan Press in March 1956).

reactors are also producers of atomic power; they are being designed to drive submarines or surface vessels, to heat gases for jet propulsion in aircraft, and to provide electric current for portable-package power plants for military installations. In addition, reactor technology is vital for production reactors in which plutonium for atomic weapons is produced. Hence, because of the interchangeability of information, considerable secrecy of technical features remains.

This fact has several consequences of significance for public control. It means that outside analysts and public opinion leaders must guess and speculate about certain features of the various power reactors. The resulting estimates, often conflicting, cannot be affirmed or denied by government technicians for fear of revealing secret information. A general impression of confusion and uncertainty prevails. And although specially designated industrial groups are allowed access to secret technical information, this participation, no matter how widespread, is no substitute for general knowledge. Open discussion continues to be restricted, chances for special advantage obtain, and peaceful atomic power cannot be fitted completely into the normal system of democratic public control.

Yet, there is more and more publicity about the actual policy decisions which channel government and private resources into different parts of the reactor program. To be sure, the Commission classified its schedule of prices to be paid to industrial producers of special nuclear materials (plutonium and U-233). However, it revealed that the prices were based mainly on the "fuel value" of plutonium rather than the "military value" of the material for weapons use.[2] Thus, without stating these prices in the exact dollar amounts, the Commission did release enough information so that the fundamental policy decision is clear: the Government will not give subsidies to atomic power producers in the form of high guaranteed prices for produced plutonium.

In short, in spite of the remaining secrecy, general public knowledge and discussion of atomic power are increasing and will doubtless continue to grow as declassification proceeds. As more and more groups become familiar and involved, the forces of democratic control will enlarge their impact on the field of atomic power policy. It is with this trend that this paper is concerned—with both the issues that are evolving and the clashes these issues are occasioning among the various economic, social, and governmental groups which are affected by the emergence of nuclear power.

SPEED OF THE GOVERNMENT'S PROGRAM

The AEC has drawn up a Five-Year Power Reactor Development Program to guide its own efforts in civilian reactor research and development work. This is based on the policy that it is the Government's responsibility to develop power reactor technology "to the point where one or more power reactor systems are technically and economically feasible, and beyond that, to develop technology for

[2] See *Hearings before the Joint Committee on Atomic Energy on Development, Growth, and State of the Atomic Energy Industry*, 84th Cong., 1st Sess., pt. 1, at 73-76 (1955).

even more advanced types of power reactors."[3] In this program, the Commission uses mostly government money for planning and building experimental reactors of moderate size, although it was decided in 1953 to build one large-scale facility, the pressurized water reactor and power plant now under construction at Shippingport, Pennsylvania.

This program requires only brief comment, for it has never been the subject of controversy. It is true that the National Coal Association publicly deplored the Government's decision to[4]

> . . . use huge amounts of taxpayers' money to construct, or to subsidize the construction of, numerous permanent installations [*e.g.*, the Shippingport reactor] which admittedly will not be capable of producing electricity at a price which is competitive with coal.

However, even the Coal Association did not take issue with the AEC's five-year program as a whole, but simply recommended that the Government concentrate on laboratory research and temporary, pilot-scale experimental plants to obtain knowledge which would render nuclear power useful at a later time.

The lack of opposition to the AEC's civilian reactor program is traceable to the fact that several groups see value in it for different reasons. Those who favor the United States' progress in peacetime atomic power for international reasons are encouraged. There are practical arguments that the greatest industrial nation on earth will remain so only if we lead the world in every race for new technological discoveries. Quick achievement of practical atomic power is deemed to be in the public interest, and there is general agreement that the United States Government should continue to take the lead in its attainment. Among the economic groups affected by nuclear power, the electric utilities and equipment manufacturers are glad to have the Government provide the cost of research and development which will eventually lead to a technology usable by them. The advocates of public power are pleased to have atomic power technology remain in government hands so that their rivals in the private-power field cannot get ahead of them and freeze them out of the new field. Liberal and labor groups who hope for a government-operated atomic power system share this view. Finally, the armed services believe that atomic power reactors for military propulsion are amply provided for and generally favor the development of civilian power as a complementary program. With such wide support, the Commission seems likely to move ahead at a rapid pace on its civilian reactor program.[5]

UTILIZATION OF RESOURCES: MILITARY V. CIVILIAN

The fact that civilian atomic power had its inception primarily in a military program brings up the issue of the allocation of resources between military and

[3] Joint Committee on Atomic Energy, *Current Statement of the Atomic Energy Commission on the Five-Year Reactor Development Program*, 84th Cong., 1st Sess. 1 (1955).

[4] *Hearings, supra* note 2, pt. 3, at 475-76.

[5] For a detailed exposition of the attitudes of these various groups towards the AEC's reactor program, see *Hearings before the Joint Committee on Atomic Energy on S. 3323 and H.R. 8862, to Amend the Atomic Energy Act of 1946*, 83d Cong., 2d Sess., pts. 1 and 2 (1954).

civilian uses for atomic power. In general, as already stated, the position of the military is that civilian applications are not competing with military. Thus, Department of Defense representatives have stated that they strongly support developing the peacetime uses of atomic energy and broadening the scope of industrial participation.[6] Although agreement has been reached in principle, this does not mean that the military interest will not be asserted where a scarcity of resources requires a choice between military and civilian application. And when a threat to the military program arises, the military has powerful spokesmen in the Joint Committee on Atomic Energy, where six of the nine House members serve also on the Committee on Military Affairs.

One military-civilian conflict arose in early 1955 over President Eisenhower's proposal for the immediate construction of an atomic-powered merchant ship with a reactor like that of the Nautilus. Among those elements most active in support of this proposal were the Merchant Marine and Fisheries Committee in the House and the Interstate and Foreign Commerce Committee in the Senate.[7] Arguments based on the propaganda war with the Soviet Union were brought up, and it was asserted that unless we acted promptly, the Russians might "beat us to the punch." Further, AEC Commissioner Libby asserted that the peace ship would not be built "at the expense of submarines, or the airplane, or any of the military programs." Admiral Rickover, the Chief of the AEC's Naval Reactor Branch, however, expressed the view that the merchant ship would result in the delay of the navy program, and painting a pessimistic picture of any kind of merchant ship program, he urged, instead, the development of a large ship reactor prototype, which would be of subsequent use in merchant vessels.[8] After considering the question, the Joint Committee, apparently fearing a drain of resources away from experiments on military propulsion reactors if the plan were carried out, voted not to authorize the peace ship.[9]

What of civilian central-station power reactors? Basically they too are in competition for resources with military propulsion reactors. Although central-station reactors are simpler in design than ship propulsion reactors because they do not involve weight and size limitations and other special features, they use the same materials and are based on the same technology, which puts them in competition for the limited number of trained technical personnel. In this case, as with propulsion reactors, the forces pressing for civilian power are strengthened by the growing importance of the atom in foreign policy, which tends to suppress the doubts of the military

[6] See *id.*, pt. 2, at 733.

[7] Representative Herbert C. Bonner (D., N.C.) and Senator Warren G. Magnuson (D., Wash.) are the respective chairmen of these committees, and they led the fight for authorization of an experimental atomic-powered merchant ship. See, for example, Senator Magnuson's statement, 101 CONG. REC. 8920 (daily ed. July 13, 1955).

[8] This discussion of the peace-ship proposal is found in *Hearings before the Subcommittee on Authorizing Legislation of the Joint Committee on Atomic Energy*, 84th Cong., 1st Sess. 78-92, 118-21 (1955).

[9] See 101 CONG. REC. 7944-46 (daily ed. June 27, 1955).

point of view. The cold war must be waged, it is argued, at the same time that preparations are made for the strongest possible defense in case a hot war should develop.

There remains, then, a clear potential rivalry between the military reactor program and both civilian propulsion reactors and central-station power reactors. The clash of interests results from a competition in the Government's program for priority to employ the limited number of contractors and technicians capable of doing this work. Although there appears to be general agreement that a civilian program is necessary, disputes such as that over the merchant ship may continue to arise as both the military and civilian programs are pushed rapidly forward.

THE AEC PRODUCTION PROGRAM AND CIVILIAN POWER

The production of fissionable materials is the prerequisite for work in all phases of atomic energy. Two roads, both of which have been used by the Government since 1945, lead to production of these materials. One is the separation process in which the fissionable isotope, U-235, is taken out of the stable form, U-238, in a gaseous diffusion plant. The other is the conversion of a blanket of U-238 into fissionable plutonium (Pu-239), or a blanket of thorium (Th-232) into the fissionable uranium isotope, U-233. This is done in a converter reactor in which the neutrons given off in the fission process are used to transmute nonfissionable materials into fissionable materials, some of which, by a chemical separation process, may then be extracted for further use.

Much thought has been given to a program which would permit the use of the heat generated in a production reactor in the latter process for transformation into power. Thus, a converter or a breeder reactor could produce power as well as fissionable materials. This possibility, however, poses many problems. Naturally, the technology to support this "dual-purpose reactor" is much more complicated than that required to concentrate on materials or power alone. Aside from this engineering difficulty, there are policy issues to resolve. Should the Government buy up privately produced fissionable materials at a price guaranteed for a long period? Without such a guarantee, private industry would be unwilling to build and operate power reactors which are not economically practical for their power production alone. Would encouragement to enter into atomic power on this subsidized basis not slow down the attainment of economically practical power? Is the need for weapons-grade plutonium unlimited; and if not, should the Government pay the "military value" for plutonium or merely the "fuel value" which it would have if it were to be used in another reactor?

Although these and related questions have caused considerable debate in hearings of the Joint Committee, they have, as we have seen, been generally resolved by the decision that the Government should not encourage public utilities to produce atomic power by means of guarantees of high prices for the produced fissionable materials. In this, the United States has parted company with Great Britain. The British

reactor program has been "largely slanted toward the breeding of other fissionable fuels, in addition to the production of power."[10]

It is not the purpose of this article to set forth the arguments on both sides of this issue. Both appear to have solid reasoning behind them. The pertinent question is: how has public control operated so that those who opposed long-term subsidized plutonium prices have carried the day?

The opening of the policy debate can be attributed to a speech by Charles A. Thomas, President of Monsanto Chemical Company, on June 11, 1950.[11] His proposal was for industry to own and operate a duel-purpose reactor, with the Government making it attractive by giving participating companies long-term contracts to purchase plutonium and by-products so that their capital could be amortized. This was followed by a similar recommendation from former AEC Chairman David E. Lilienthal, who took the same position in a *Collier's* article in July 1950.[12] Out of this ferment came the proposal of the Detroit Edison Company and the Dow Chemical Company to be permitted to undertake a study of stationary nuclear reactors.[13] And in January 1951, the AEC announced its Industrial Participation Study Program, in which private business could be cleared to investigate atomic power technology.[14]

During 1952, the Commission continued to arouse interest in industrial participation, and the dual-purpose reactor was mentioned frequently as a fitting incentive. Meanwhile, however, the Commission's own reactor development program was proceeding apace, its technological knowledge was growing, and it was following a program of expansion of its facilities for production of fissionable materials, the biggest increase in which was to be reflected in the appropriations bill in the summer of 1952. This expansion program, it was determined, was to be for materials production only, and, in a sense, this policy decision partly foreclosed a combined power and production program that might have been adopted instead.

Industry, however, continued to consider variations on the dual-purpose theme. In the fall of 1952, Walker Cisler, President of Detroit Edison, articulated the view of one prominent utility group in a speech before the National Industrial Conference Board.[15] He did not feel that it was necessary to establish a price for the atomic by-products as an incentive for private capital to build and operate commercial-sized nuclear power plants. Nor did he think that a market for the materials would be lacking. And the proposal submitted subsequently by the Dow-Detroit Edison group included selling plutonium to the Government but also stressed that such material had a prospective market for reactors to propel ships, submarines, and aircraft.

[10] *Hearings before the Subcommittee of the Senate Committee on Appropriations on H.R. 6766, Public Works Appropriations, 1956*, 84th Cong., 1st Sess. 15 (1955).

[11] The pertinent portions of this address and the text of the Monsanto proposal are reprinted in Joint Committee on Atomic Energy, *Atomic Power and Private Enterprise*, 82d Cong., 2d Sess. 277-80 (1952).

[12] See *id.* at 285-91.

[13] See *id.* at 296-97.

[14] See *id.* at 297-301.

[15] See *id.* at 365-70.

At the same time, inside the Commission, a clearer policy line seemed to be taking shape on the dual-purpose reactor. It was that the Government could not afford to guarantee a plutonium market to builders of industrial reactors. The AEC saw the problems incorporated in the question of whom to let into the guaranteed and subsidized price program and whom to leave out. The long-term guarantee of prices for materials produced in what would probably be obsolescent plants also gave them reason to hesitate to make such commitments.[16]

Against this background, in the fall of 1952, the Joint Committee staff members undertook a general survey of the thinking of business and scientific communities regarding atomic power.[17] It became evident that there was a divergence of viewpoint among the three chiefly-concerned businesses. Electric utilities were determined to enter more boldly into atomic power than they had done in the case of hydro-electric power, but they were not eager to be tied to a government market. Equipment manufacturers, like General Electric, Westinghouse, and Allis-Chalmers, were interested in the rapid development of power reactors by any route, whether subsidized by government purchase of fissionable materials or not. They saw in atomic energy a potential low-cost fuel to keep power costs low and power consumption rising. Lastly, chemical companies proved to be more interested in manufacturing fissionable materials and in developing extensive uses of fission products than they were in atomic power per se.

Further, at the hearings called by the Joint Committee in 1953, the concensus of the witnesses was that the difficulties in designing economically practical power plants were largely technical. Consequently, there was a strong incentive to concentrate on "power-only" reactors in order to simplify the technology. A general "shying away" from subsidy in the form of high plutonium prices was noticeable.[18]

Nevertheless, in the 1954 hearings on the new act, the AEC still gave evidence of wanting to keep all approaches open.[19] Its statements purposely kept the possibility of high prices for plutonium in the picture, but no commitments to a definite policy were made. Representatives Holifield and Price, however, saw in the combination of government ownership of special nuclear materials and a provision for a 40-year production facility license the likelihood of hidden subsidies to dual-purpose reactor operators. Although they persuaded the Joint Committee to limit any guaranteed fair price to seven years, they saw in the AEC's discretion to set these prices the possibility of subsidies of undetermined magnitude.[20] Labor union repre-

[16] On the AEC's thinking at this time, see an address by Commissioner Zuckert, delivered before the Chicago Section of the American Chemical Society, AEC Release, Sept. 11, 1952. The Commissioner posed some of the difficult problems involved in the dual-purpose approach and suggested that "power-only" reactors might possibly be the solution.

[17] See *Atomic Power and Private Enterprise*, *supra* note 11, at 33-56.

[18] See Joint Committee on Atomic Energy, *Summary of the Hearing before the Joint Committee on Atomic Energy*, 83d Cong., 1st Sess. 4-9 (1953).

[19] See *Hearings*, *supra* note 5, pt. 2, at 570-71.

[20] See Joint Committee on Atomic Energy, *Report to accompany H.R. 9757, Amending the Atomic Energy Act of 1946, as amended, and for Other Purposes*, H.R. REP. No. 2181, 83d Cong., 2d Sess. 130-31 (1954).

sentatives, desiring government ownership of reactors, were also opposed to subsidizing private reactors by high prices for their production of fissionable materials.[21] The utilities, too, were decidedly cautious concerning the pricing section. Walker Cisler, of Detroit Edison, repeated his preference to have the utilities free to dispose of the material as they wished rather than be tied to a government market.[22] And others pointed out the danger of retarding the reactor program as a result of the Commission's reluctance to license reactors because it would thereby incur large obligations to purchase special nuclear material.[23] Only General Electric and the private laboratories felt that purchase by the Government was desirable and suggested that the AEC should contract for special nuclear materials at firm prices and thus provide a strong incentive for private investment in dual-purpose reactors.[24]

The passage of the act left the Commission free to decide the issue. Its secret price lists were announced in January 1955. As later interpreted, these were based on a policy of a "power-only" reactor, since the by-product fissionable material was to be priced, in the long run, as reactor fuel rather than for weapons purposes. AEC spokesmen have explained the decision as based on (1) technical contradictions and (2) the problem of fitting together power supply and plutonium supply.[25] The Commission had decided that the dual-purpose route simply was not one which by itself would lead to economic atomic power. If the AEC had "up its sleeve" a 20th century Homestead Act to encourage pioneering in nuclear power plants, at least it was not going to exercise its prerogatives by means of high prices for fissionable materials.

As a result of this policy, it was not possible for private investment alone to finance and construct atomic reactors, supported by high prices to be paid by the Government for materials produced. Instead, a period of joint undertakings became necessary, a period of cooperative government-industry work toward achieving competitive "power-only" plants.

THE INTEGRATION OF GOVERNMENT AND BUSINESS

When the Government carries out a program of power reactor research and development by means of contracts, the question of the extent of the government effort is resolved in terms of appropriations. But when a jointly financed undertaking is planned, the problem of how—and where—to draw the line between government aid and business expense becomes a complicated policy issue.

The rationale of government aid is important. It is justified because of private contributions to national defense. Rapid tax amortization and direct government financing at low interest rates are cases in point. The Duquesne Light Company has applied for this aid for its power plant being built at Shippingport, Pennsylvania,

[21] See *Hearings*, *supra* note 5, pt. 1, at 486-514 (1954).
[22] See *id.* at 76-77.
[23] See *id.* at 377-98.
[24] See *id.* at 349, 428.
[25] For a discussion of AEC thinking on this matter, see *Power Reactor Development in the United States*, an address delivered before the Canadian Electrical Association by W. Kenneth Davis, Director, Division of Reactor Development, AEC Release, June 29, 1955.

in connection with the AEC's pressurized water reactor.[26] Government aid is also justified as paying for knowledge which will generally advance a technological art in the public interest. The National Advisory Committee for Aeronautics operates on this rationale, and the AEC's reactor demonstration program has the same basing.

What forms should AEC aid take? The Commission has announced its policy: not to "hide a large part of this [aid] in the price paid for materials which will be produced by these reactors" but rather "to bring it out in the open where it is a clear-cut research and development assistance."[27] This thus rules out the possibility of setting the secret prices for privately produced fissionable materials much higher than the materials really cost to produce. In addition, the AEC announced that it would charge private firms for materials "burned-up" or lost, and that it would charge the full costs of fuel fabrication and chemical processing, two services to be performed for industry by the Government.[28]

The AEC did, however, make available three types of aid:[29]

> . . . waiver of the charge that the licensee would otherwise have to pay for the use of special nuclear material furnished by AEC; performance in AEC laboratories and test facilities without charge to licensees of certain mutually agreed upon research and development work; and financial assistance under appropriate research and development contracts.

This assistance could be arranged to suit the private firm's need in each undertaking approved under the AEC's Power Reactor Demonstration Program, in which the Commission asked for industry proposals on constructing power reactors under license and indicated that those receiving the least amount of government aid would have a greater chance of acceptance. Clearly, this aid was to be tailored to the need of each reactor project. The AEC, as we have seen, has described it as "clearcut research and development assistance." Provided the dollar equivalents of the services made available by the AEC to each project are made known, this aid will be open and not hidden. Yet, because it will differ in each case, it will be hard to explain why a greater private share could not have been bargained out in each case.

The policy of giving this form of aid is by no means a settled one. There was controversy over the decision to tie in research and development contracts with licenses to construct and operate civilian power plants. In fact, some doubt is cast on the legality of this scheme by the 1954 act's section 169, which prohibits funds from being employed in the construction or operation of licensed facilities except under research and development contracts or agreements.[30] Representative Cole took issue with the AEC; he interpreted the provision—in keeping with the legislative history, he said—to allow the Commission to pay for research work only after

[26] See *Hearings, supra* note 2, pt. 1, at 90-101.
[27] *Id.* at 169.
[28] See *id.* at 74-75, 180.
[29] *Id.* at 152.
[30] The text of this section is as follows: "No funds of the Commission shall be employed in the construction or operation of facilities licensed under section 103 or 104, except under contract or other arrangement entered into pursuant to section 31. . . ." 68 STAT. 952, 42 U.S.C.A. §2209 (Supp. 1954).

private facilities were built. Senator Anderson also exhibited uneasiness about this kind of aid or subsidy. However, other Joint Committee members defended the AEC's judgment in proposing the scheme.[31]

Later, at the hearings in May 1955, Representative Holifield and Joint Committee Staff Member Walter Hamilton developed the interpretation that judgment must be made, in each case, whether the research assistance results in greater benefit to the technological art or to the individual company. At this hearing, the AEC offered its solution to the problem—interpreting section 169 to prevent the Government from giving away title to any part of a reactor (bricks or mortar) built by the Government as research assistance.[32]

Aside from this issue of legality, Representative Durham was not satisfied with the idea of a different amount of government aid in each case. Recognizing that favoritism and special treatment for different industrial firms or regions of the country must be avoided if possible, he desired a formula from which to derive the amount of money the federal government would put up for each project combining business and federal funds. His idea was to have a fixed percentage—say 25 per cent —so that a firm in one region would get the same treatment as one in another. But the AEC immediately pointed out the impossibility of this by citing the example of the need for a demonstraton homogeneous reactor. Since no industry proposal for one had been made, the Government had to be free to arrange a higher contribution to induce some firm to contribute some of its own money.[33]

A related problem arises out of the fact that the introduction of private money into reactor work may become such a goal in itself that it may be furthered at the cost of the government program. For example, the House Appropriations Committeemen, in July 1955, eliminated money for the Power Reactor Acceleration Program. They did so because the program was not spelled out in the justifications, but they could easily have taken up the argument that the public money should be shut off in order to encourage more private money to be invested. Specifically, Representative Holifield cautioned the AEC against warping the program just because it wanted to get a private firm to operate the Engineering Test Reactor. He counseled: ". . . do not worship the fetish of getting outside money in, to the point where you do it at the long-term detriment of the Government. . . ."[34]

All in all, the dividing line is not clear-cut, and charges of "give-away" haunt anyone who embarks on one of these combined programs. The lag in announcing arrangements under the Power Demonstration Reactor Program was probably due in part to complications of this nature. Understandably, the Commission was careful about entering into commitments of this kind as the present transitional period

[31] For this debate, see *Hearings, supra* note 2, pt. 1, at 154-79.

[32] See *Hearings, supra* note 8, at 49-57. This AEC formula was subsequently adopted. See *The Power Demonstration Reactor Program*, remarks prepared by Louis H. Roddis, Jr., Deputy Director, Division of Reactor Development, AEC Release, Sept. 27, 1955.

[33] See *Hearings, supra* note 8, at 13-14.

[34] *Id.* at 106.

involves it in a crossfire of views on the amount and kinds of government aid which it should dispense. The voices are rising from every quarter of the domestic scene. The announcements by the Russians at Geneva that they have found economically practical atomic power will increase the clamor for rapid development and government aid. At the same time, the voices of caution and restraint against pampering American industry will not be silenced. The AEC will find its decisions becoming progressively more subject to the conflicting influences of public opinion.

QUICK DEVELOPMENT BY "INSIDERS" AND POTENTIAL MONOPOLISTS

V. CONTROLLED AND EQUAL ACCESS

The incipient atomic power industry consists in part of equipment manufacturers who will be in the business of building and selling reactors and components. Several giant firms, such as General Electric, Westinghouse, and Allis-Chalmers, lead the field. These companies have been principal contractors and subcontractors of the AEC, chosen because they have been judged to possess the industrial capacity to provide the best management for AEC facilities. As a result, they are at great advantage over other companies. They have acquired technically trained staffs and valuable experience in solving reactor problems.

The economic organization of American industry is, thus, brought into the picture. A question arises: should the results of government research and development be exploited by the small group of large industrial firms, or should the benefits of government discovery be widely distributed? Put in these terms, an affirmative answer to the latter question becomes the rallying cry of liberals.

A conflict of objectives of public policy is involved here. A quick exploitation by private enterprise would be achieved by letting the competitive position of these firms determine the outcome of their economic rivalry. Yet, a public policy of distributing the benefits of the new technology broadly would require a positive governmental program to aid other firms to move into the business and, at the same time, to restrain those with a "head-start." The AEC has attempted to expand the group of knowledgeable firms. The study agreement program was for that purpose. The hiring of new contractors for the AEC's five-year power reactor program, such as North American Aviation, has had the same end. The letting of the contract to Westinghouse for the 60,000 kilowatt pressurized water reactor power plant ignored this policy, but the AEC explained that very few companies were able to do this job at all because of insufficient access to technical knowledge.[35] And the invitations for bids on the power-package reactor provided another opportunity to bring new firms into the atomic power business.

On what basis to make the awards has created a problem. If the bids which are most economical for the Government are accepted, these are likely to come from

[35] Similarly, Westinghouse and General Electric held all contracts in the naval reactor development program until a contract for a small submarine reactor was awarded to Combustion Engineering, Inc., in August 1955. See AEC Release No. 677, Aug. 11, 1955.

the firms with the most experience, money, and assets—and the policy of distributing widely the know-how developed by tax dollars will be thwarted. On the other hand, if bids from inexperienced companies are accepted, no firm assurance of their competency to do the work efficiently is present, especially since they will probably not be able to outbid the experienced firms for the few technicians available. Hence, without an aggressive governmental policy to spread the benefits at the cost of quick private development, the large equipment manufacturers have a good chance of gaining a great share of the new market.

The issue of market leadership also involves the matter of patents, for it has been the patented processes which held the market for the two or three big concerns in electric generating equipment. At the hearings on amending the Atomic Energy Act, business interests presented a solid front for firmer patent rights in inventions.[36] Opposed, however, was an underlying fear in Congress lest the advantage now held by a few companies already engaged in atomic energy work (principally AEC contractors) would give these companies an unfair advantage over competitors, and even a dominant position and accompanying monopoly. As a result, provisions to prevent insiders from converting their advantage into a monopoly were written into the bill. One was the so-called compulsory patent licensing (operable until September 1, 1959), by which the AEC, after satisfying a great array of conditions, can require a patent holder to license another firm.[37] The other was a provision which gives the AEC title to any invention conceived in the course of any contract, arrangement, or relationship with the AEC, regardless of whether funds of the AEC are involved, although the Commission has the power to waive such claim.[38] Thus, as long as the AEC continues a tight policy on releasing inventions for private firms to patent, the threat of advantaging "insiders" appears to have been defeated. Pressures will, of course, be directed at the AEC, in whose discretion the patent policy now falls, but the threat of a charge of "give-away" hangs over the Commission's head and serves as an impediment to sweeping waivers of any kind.

The chemical firms were also much concerned that patents be allowable in atomic energy work. However, since the AEC has followed a policy to the effect that all chemical processing will be done for some time by the Government under contract, the chances for these firms to be in a position to obtain patents is remote.

Because of the general congressional concern lest monopoly find a suitable breeding ground in atomic energy, no special dispensations with respect to the operation of the federal antitrust machinery were inserted in the 1954 act—in fact, it is explicitly stated that the antitrust laws are applicable to all licensees. Furthermore, the AEC must report promptly to the Attorney General any conditions which appear to tend

[36] See *Hearings, supra* note 5, pt. 1, especially the testimony of Babcock and Wilcox Co., at 92, Dow Chemical Co., at 104, and General Electric Co., at 334.

[37] §153. 68 STAT. 945, 42 U.S.C.A. §2183 (Supp. 1954).

[38] §152. 68 STAT. 944, 42 U.S.C.A. §2182 (Supp. 1954). These and cognate patent problems are discussed more fully in another article in this symposium. See Boskey, *Some Patent Aspects of Atomic Power Development, infra*, 113-31.

toward the violation of these laws. And before a competitive license can be issued, the Attorney General is to advise the AEC publicly whether the proposed license tends to "maintain or create a situation inconsistent with the antitrust laws."[39]

The risk-dividing way to share the burden of development in this new field, however, is by means of groups of companies. Study groups are on this basis, and presumably power reactors will be feasible for several power companies banded together. Accordingly, conflicts with the Public Utility Holding Company Act and the antitrust acts may possibly arise. To obviate any difficulty in this connection, therefore, the Detroit Edison group has formed a nonprofit corporation for its proposal to build an experimental prototype of a breeder reactor.[40]

In addition to the combination of public utilities alone, there was also the distinct possibility of a vertical industral organization, a type of combination which had encountered difficulty with the antitrust laws in the past. By this means, a single business could produce power in a dual-purpose reactor, chemically separate fissionable materials from the reactor core, and convert the by-product materials to chemical uses of various kinds. The Dow Chemical Company in the Detroit Edison group offered the opportunity for such a vertical combination. However, when the AEC's policy of not underwriting high-priced plutonium production and of not relinquishing chemical processing to private enterprise became apparent, the Dow Chemical Company withdrew from this group.[41]

Regardless of its legality under existing law, affiliation of private power companies is feared as monopoly in many quarters. These combinations are considered to be a threat by those who believe in public power and its yardstick as the only effective form of competition in the electric power industry. This viewpoint was strongly expressed in the Interim Report on hearings on monopoly in the power industry, held in 1953 and 1954 by Senator Langer's Subcommittee on Antitrust and Monopoly Legislation. The Subcommittee expressed the gravest concern over a new "surge of monopoly" in the power industry. It found, first, "that there is a two-pronged drive by private monopoly to destroy public competition in the power business"; and second, "that Wall Street domination of the power industry has revived many of the holding company evils which Congress sought by legislation to suppress, particularly the extension of monopoly control over very wide regions."[42] The pattern of abuse by private utilities, said the Subcommittee,[43]

> . . . indicates the difficulties, and often impossibilities, of effective State regulation. . . . The hearings further developed alarming evidences of the failure of the Public Utility Holding Company Act to accomplish its purpose, e.g., to protect the public against the domination of operating companies by holding companies, excessive service charges, and all the monopolistic devices which tend to increase rates and restrict service.

[39] §105. 68 STAT. 938, 42 U.S.C.A. §2135 (Supp. 1954).
[40] See *Hearings, supra* note 2, pt. 2, at 236-37, 252-53.
[41] See *id.* at 243.
[42] Senate Committee on the Judiciary, Interim Report, *Monopoly in the Power Industry*, 83d Cong., 2d Sess. 4 (1954).
[43] *Id.* at 7.

The Subcommittee indicated its view that the Republican administration had aided this dangerous trend toward the destruction of competition by a repudiation of the all-important "antimonopoly instrument of democracy," the yardstick.

Much of this desire to prevent monopoly of any kind in the atomic power industry rallied around an insistence upon retaining section 7(b) of the McMahon Act.[44] Briefly, this provision required the Commission to report to the President if and when it believed any industrial, commercial, or other nonmilitary use of fissionable material had been sufficiently developed to be of practical value. In the report, the Commission had to estimate the economic, political, and social ramifications of such developments. The President then submitted it and his own recommendations to Congress. Until ninety days had elapsed, no license could be issued. This procedure was taken as insurance that the atomic industry could not be born to monopoly without a full open dicussion under the winds of public opinion. Labor unions supported this view, and found another reason for such a report in the danger of technological replacement of workers in the coal and oil industries.[45] Contrariwise, advocates of quick assumption of responsibility by private enterprise were unalterably opposed to the section 7(b) report. David E. Lilienthal sharply criticized the report as applying a brake on progress, because all groups opposed to the growth of an atomic energy industry could unite in lobbying Congress to stall the industrial development of civilian atomic power.[46] In various stages of the 1954 act, the provision was successively weakened until it required merely a finding in writing by the Commission alone before it could issue competitive commercial licenses under section 103.[47] As these will not be feasible for some time, the report is of small significance at present. Meanwhile, however, by means of the gradual private assumption of responsibility, aided by AEC research and development contracts, the framework of the atomic power industry in great measure will have taken shape before issuance of the requisite "finding of practical value."

Still another aspect of the competitive position of industry involves public policy. Business firms working for the Commission could attempt to exert influence in behalf of policies designed to improve their relative standing vis-à-vis their competitors. The Joint Committee recently has evinced a suspicion of this. Concerning General Electric's recommendation of a high pressure water design for the submarine advanced reactor, it raised the question whether the company urged this type so as to catch up with Westinghouse, which had had all previous experience in this field.[48]

[44] 60 STAT. 764, 42 U.S.C. §1807(b) (1946).

[45] Mr. Andrew J. Biemiller, member of the National Legislative Committee, AFL, advocated retention of the §7(b) report in the hearings on the amendment of the 1946 act in May 1954. See *Hearings, supra* note 5, pt. 1, at 271. And at the first hearings subsequent to the passage of the new act, he reiterated this suggestion. See *Hearings, supra* note 2, pt. 2, at 325, 327. See also the letter from Anthony Matz, International President of the International Brotherhood of Fireman and Oilers, *id.*, pt. 3, at 588.

[46] See note 12 *supra*.

[47] §102. 68 STAT. 936, 42 U.S.C.A. §2132 (Supp. 1954).

[48] See *Hearings, supra* note 8, at 68-69.

Concern over the likelihood of creating a monopoly in the atomic energy industry is pronounced in the speeches and testimony of labor and public-power advocates. Several of the liberal Congressmen have joined them. On the whole, however, these pressures have not been strong enough to instigate precautionary measures of any consequence for the AEC.

REGIONAL INTERESTS V. ECONOMIC PROGRESS

The prospects of atomic power have excited regional interests. The coal-mining areas have been represented by the National Coal Association and the miners' unions. The Coal Association urged that if government subsidization of the construction or operation of full-scale permanent nuclear power plants were deemed necessary, these facilities should be built outside of coal's normal market areas. The coal industry, its spokesman said, feels it is entitled to ask that taxpayers' money not be used to subsidize its competition. The unions held that the exploitation of nuclear power should be done by the Government for the high-cost power areas. Congressmen from Pennsylvania have reportedly questioned the location of the PWR in that state.[49]

On the other hand, high-cost power areas asked for government-generated nuclear power. A proposal from Nevada interests for nuclear power for mining and irrigation was put forward.[50] But since the prevailing policy was to turn to private business to finance in great part the full-scale prototypes of nuclear power plants, this proposal fell on barren ground. In Minnesota, likewise, political pressure arose for government help for a rural electric atomic power plant.[51] However, the REA, in a Republican administration committed to curtail expansion of public power, was not in a position to be very active in such gathering pressure. It is questionable whether sufficient momentum can be gained in these areas to enlist a disinterested AEC in helping work out the technical and financial details of such projects. The easiest course is to rely on the large utility groups, which, because they are technically experienced and financially backed, can carry forward reactor projects with the minimum of guidance from the AEC.

These groups are headed by the large power companies of several metropolitan areas. Consolidated Edison of New York was first to make a straight noncompetitive license application; Detroit Edison and Commonwealth Edison of Chicago were the first to gain AEC acceptance of their proposals under the Power Demonstration Reactor Program.[52] Clearly, the large cities are going to have atomic power

[49] The point of view of the coal-mining regions was expressed to the Joint Committee by spokesmen for the National Coal Association. See *Hearings, supra* note 2, pt. 3, at 475-87.

[50] See *Atomic Power and Private Enterprise, supra* note 11, at 23-24.

[51] The proposal for such a plant is reported in N.Y. Times, Aug. 9, 1955, p. 8, col. 2.

[52] See AEC Authorizes Action Toward New Nuclear Power Reactors, AEC Release No. 674, Aug. 8, 1955. Although the Commonwealth Edison group was apparently responding to the AEC's Demonstration Reactor Program, it matched Consolidated Edison in proposing to bear the total cost of its nuclear plant, as the New York utility had done. Similarly, Commonwealth Edison requested a licensing arrangement for its plant.

first, although the policy intent of the 1954 act appeared to favor the high-cost power areas.[53]

PRIVATE POWER v. PUBLIC POWER

The prospect of a major new source of electric energy has set the forces of private power jockeying for position against the forces of public power. In the background of this rivalry over the atom is the history of hydro-electric power generation. The possibility of harnessing falling water to produce power was neglected by private power groups, with the result that the federal government moved in to construct dams and central-station generating plants. The power generated was given on a preferred basis to public corporations, which distributed it in cities and rural power districts. The federal government also encouraged these public bodies by loans to build up their distribution systems. In addition, federal power policy incorporated the idea of preference for public bodies in securing licenses for hydro-electric generation in case the federal government itself did not use the falling water.

The concept of water in streams as a natural resource of the federal government, to be used for the citizens of the area without including a profit for the shareholders of a private corporation, thus, became the creed of the liberal thought of the Western states. Federal sale of hydro-electric power at rates below those charged by the private companies of the area became another rallying cry. Known as the "yardstick" device, it was looked upon as the only effective way of preventing private power companies from taking advantage of the natural situation of one distributor for one geographic area. It was alleged that state regulatory commissions were largely ineffective in bringing down electric rates consistent with technological improvements in power production.[54]

As it became obvious that the future would see practical atomic power, the private power companies determined that they would not be "caught napping" as they had been in the development of hydro-electric power. They recognized that the climate of opinion was running against public power for the first time since the advent of the New Deal, and they saw a chance to keep the federal government out of nuclear power generation. They had added incentive, in that they faced a future in which conventional sources of power were becoming exhausted or excessively costly. This prospect lent a note of urgency to the development of practical atomic power.

As a result, private power has not waited for completely competitive nuclear power before spending its own money. Because large sums were required for research and development and for capitalization of future power plants, private power companies formed associations to share costs and applied for study agreements with the AEC. In this way, they could familiarize their technicians with reactor tech-

[53] The intent was stated specifically with respect to commercial licenses granted under §103. See §182(c), 68 STAT. 954, 42 U.S.C.A. §2232(c) (Supp. 1954).

[54] For a concise treatment of the evolution of government power policies, see King, *Power Policy*, in 2 EDITORIAL RESEARCH REPORTS 465, especially 469-76 (1953).

nology and acquire the knowledge needed for the next stage, *i.e.*, actual work on developmental projects. Two groups, the Pacific Northwest Power Group and the Rocky Mountain Nuclear Power Study Group, were organized by the private power companies in areas of the West which had been thoroughly invaded by public power. In addition to this study group activity, the biggest private utilities in the large urban areas seem to be eager to participate actively in building full-scale prototype nuclear plants, as indicated by their proposals under the Power Demonstration Reactor Program.

To public-power advocates, private development of atomic power is unfortunate. In reference to the formation of the Rocky Mountain study group of private power companies, Senator Anderson of the Joint Committee suggested the public-power viewpoint when he said:[55]

> The announcement that Electric Bond and Share would be the principal genius in trying to bring nuclear power to the Rocky Mountain States puts a cold shiver down the back of any person who is hopeful that we may get development in that part of the world.

Those who advocate public power realize that a continuation of the AEC in the civilian power area would be the best guarantee against private power pre-empting the field. They favor a kind of section 7(b) report on which open political forces can play in their behalf. They hope that a new "atomic TVA" can be formed to produce nuclear power and provide a governmental yardstick. Speaking chiefly through Representative Holifield on the Joint Committee, the public-power group sees a governmental obligation to distribute the benefits of federal research to help in reducing consumers' rates—a result which, it is alleged, will not occur if private power companies are allowed to pre-empt the new field.[56] The group fears that private utilities will develop atomic power in low-cost areas and require rate-payers there to pay for the costs of development. On the other hand, the argument runs, if the Government conducts the development in high-cost areas, the lessons learned there can be used for all.

The public-power bodies, however, are definitely at a disadvantage to the private companies in research and development. Most of them are small, because they came into being to fill in the areas not covered by the big private utilities. They are dependent on local approval for investment in experimental work. Because of their small capitalization, it is difficult for them to perform research and development work. This latter problem came up at the hearings on the confirmation of Dr. Libby as Atomic Energy Commissioner. The National Rural Electric Cooperative Association, using Senator Anderson as its spokesman during the hearings, asked Dr. Libby: "Do you feel the chief criterion of cooperation between AEC and these public groups should be the amount of money that a group can put up?"[57] Dr.

[55] *Hearings before the Senate Section of the Joint Committee on Atomic Energy on Confirmation of AEC Commissioners, June 1953 to March 1955*, 84th Cong., 1st Sess. 17 (1955).

[56] The approach taken by Mr. Holifield is illustrated by two lengthy statements which he made on the floor of the House of Representatives. 100 CONG. REC. 2437-40, 5598-600 (1954).

[57] See *Hearings*, *supra* note 55, at 17.

Libby replied that it was the competence of engineering staff which should govern, but he neglected to note that money can buy this talent. All in all, his reply hardly refuted those who argue that the public groups are, in fact, handicapped in their limited ability to obtain capital.

Still, public power is making a determined effort in the development of atomic energy, although it does not and probably cannot display the aggressiveness shown by the private companies. By mid-1955, four public bodies had entered into study agreements with the AEC: the TVA, the Seminole Electric Cooperative of Florida (a federation of five distributing cooperatives), the Consumers Public Power District of Nebraska, and the National Rural Electric Cooperative Association. Two proposals had been made for building medium or large-scale power plants. One proposal, from the Consumers Public Power District of Nebraska, came under the AEC's Power Demonstration Reactor Program. The other was a proposal from the Rural Cooperative Power Association of Elk River, Minnesota, to build a 22,000 kilowatt nuclear plant.[58]

These interests are aided by considerable public-power sentiment in Congress, though there is little in the AEC and the rest of the Executive Branch, as revealed by the Dixon-Yates controversy. When the new organic law for atomic energy was being written, the public-power advocates took advantage of their congressional support to insert clauses designed in their favor. The bill, as written by Representative Cole and Senator Hickenlooper, generally protected private business against public-power corporations. It prevented the AEC from becoming a power producer except incidentally as a result of experimental research and development facilities. And although the bill was amended on the floor of the Senate to authorize the AEC or other federal agencies to generate power commercially and to market it through the Secretary of the Interior under the Flood Control Act of 1944, which gives preference to public bodies and cooperatives, this provision was defeated in conference.[59]

The first of two preference clauses was put into the act in section 44.[60] This gives to public bodies and cooperatives preference in purchasing experimental and by-product power from the AEC. The by-product power provision would be important only in case the Government should build large-scale dual-purpose reactors. The preference on experimental power has required the AEC to offer the power from the land-based prototype of the submarine intermediate reactor at West Milton, New York, to three public power bodies within a reasonable transmission radius.[61]

[58] The AEC rejected the Nebraska proposal in its August 8 release, *supra* note 52, but subsequently approved a revised version as a basis for negotiation. See AEC Authorizes Reactor Power Plant Negotiations with Nebraska Power Group, AEC Release No. 723, Oct. 27, 1955. The Minnesota proposal had not then been acted upon.

[59] The text of the provision—the so-called Johnson amendment—is printed in 100 CONG. REC. 11221 (1954). For the debate, see *id.* at 11221-37, 11319-88.

[60] 68 STAT. 929, 42 U.S.C.A. §2064 (Supp. 1954).

[61] See AEC Announces Plans for First Sale of Atomic-Electric Power, AEC Release No. 663, July 13, 1955.

Another preference clause involved the granting of commercial licenses to operate production or utilization facilities. In the bill, as reported out of committee, preference was to be given only to high-cost power areas in the United States. It was amended however, to include public bodies and cooperatives. And to assure that preference agencies and others will get a full opportunity to be heard on any interest they may have, the law requires that regulatory agencies and public and private utilities within transmission distance of a proposed reactor shall all receive notice before applications for commercial licenses are acted on.[62] There is some doubt, however, about how useful this preference clause will be to the public-power groups, because they will not have the capital to put up when commercial licenses become feasible. Hence, one might expect them to prefer to have the federal government produce the power and wholesale it to them.[63]

Public and private-power groups are deeply entrenched in the fabric of American economic life. Their running and indecisive battle is destined to continue indefinitely. Atomic power, armed with the importance of its military and international aspect, will enter one of the most active battlefields of American politics. All concerned with it will find themselves involved in the struggle.

SECRECY AND THERMONUCLEAR POWER

Atomic power from nuclear fission, we have seen, is becoming more widely understood and discussed. It is increasingly subject to most of the forces of democratic control. Atomic power from thermonuclear energy, however, was almost wholly hidden behind the barrier of secrecy until August 1955. At that time, Chairman Strauss, of the AEC, admitted to reporters in Geneva that the United States had been working on the subject for a considerable time. He said that scientific progress was being made, but that no real break-through had occurred. This was the first announcement made to the American people about a program that may turn out to have enormous importance.[64]

In the period preceding the Geneva conference, certain stirrings over the possibility of fusion power were noticeable, particularly from persons connected with the Joint Committee. The former counsel of the Committee, John S. Walker, wrote an article in which he stressed the potentialities of thermonuclear power and urged that a concentrated effort to achieve it should be made by the AEC, in a new lab-

[62] See §§182(b), (c). 68 STAT. 954, 42 U.S.C.A. §2232(b), (c) (Supp. 1954).

[63] On the comparatively unfavorable financial situation of the public power systems, see *Hearings, supra* note 2, pt. 2, at 412-13. Appended to the main issue over public versus private power is the question of who will pay for the costs of development by private power companies. The ratepayers and the stockholders are involved. How the burden will be shared—and how the expenses will be recouped—is a complicated subject beyond the scope of this paper. It partly depends on the rulings of state regulatory commissions in allowing developmental expenses as part of the deductible expenses in rate-making.

For a more extended discussion of the problems of public power in an atomic context, see Marks, *Public Power and Atomic Power Development, infra*, 132-47.

[64] Chairman Strauss's revelations were made at a press conference held by the United States Delegation to the International Conference for the Peaceful Uses of Atomic Energy, at Geneva, Switzerland, on August 11, 1955. See N.Y. Times, Aug. 12, 1955, p. 1, col. 1.

oratory divorced from nuclear weapons work.[65] Chairman Anderson, of the Joint Committee, in a speech delivered shortly before the Geneva conference opened, made reference to the possibility of fusion power, and asked the dramatic question: "Will we be able to tell the world, at Geneva, whether we are trying our hardest to find out whether [the production of thermonuclear power] can be mastered?"[66]

The Joint Committee has always been among those most eager to see the greatest possible development of the military uses of thermonuclear energy, and Senator Anderson's remarks, together with prior references by other members, suggested that the Committee's stress on fusion carry over into the peacetime field. This was borne out by later statements from three Committee members, Senator Anderson and Representatives Price and Hinshaw, upon their return from Geneva. The three legislators suggested that the United States was "fumbling" in its program for fusion power, and revealed that the Committee had repeatedly urged the Commission to "put forth the maximum possible effort" in this significant area.[67]

The AEC, however, has taken a limited approach to fusion power. Chairman Strauss said enough at Geneva to show that our program is clearly not an all-out effort. It is a "very long-range" program, he said, and on a moderate scale. He gave assurances that the work is not of such magnitude as to jeopardize the future of the strong program under way to achieve cheap fission power.[68]

It is clear that policy issues are buried here, perhaps issues of the greatest significance. It is equally clear that democratic public control is virtually impossible. The statements and allusions made thus far are extremely vague and uninformative. Chairman Strauss indicated certain policy decisions which had been made—*e.g.*, that a program should be carried on, and that it should be only a small, long-range effort—but he gave outsiders no basis whatsoever for evaluating these decisions. No facts have been released on which an opinion can be built. It may be that such strict concealment is necessary, although former Commissioner Smyth has advocated outright lifting of the veil of secrecy in the thermonuclear field.[69] In any case, democratic control under these conditions is severely handicapped.

[65] Walker, *Thermonuclear Reactions: Can They Be Used for Man's Benefit?*, 33 FOREIGN AFFAIRS 605 (1955).

[66] Address of Senator Clinton P. Anderson before the Summer Conference of the Advertising Executives' Association, Inc., Joint Committee on Atomic Energy Release, July 12, 1955.

[67] See N.Y. Times, Aug. 24, 1955, p. 6, col. 3. On August 25, 1955, Senator Anderson further suggested that the President himself issue "a public directive which would mobilize our scientific and industrial power behind an effort to achieve controlled thermonuclear reactions." Revealing that approximately $33,000,000 was being spent in the controlled hydrogen field, the Senator also suggested that "we immediately step up the rate and scale of our spending on controlled hydrogen energy." *The Businessman's Atom*, address of Senator Clinton P. Anderson before the Cleveland Rotary Club, Joint Committee on Atomic Energy Release, Aug. 25, 1955.

[68] Press Conference, United States Delegation, International Conference for the Peaceful Uses of Atomic Energy, Geneva, Switzerland, Aug. 11, 1955. See N.Y. Times, Aug. 12, 1955, p. 1, col. 1. A few more details were revealed in a subsequent press conference by Mr. Strauss. See N.Y. Times, Oct. 4, 1955, p. 1, col. 1. Entitled "Project Sherwood," the program was described in terms of the places and directors involved. The amount of money being spent was stated merely as "significant."

[69] See speech before the National Industrial Conference Board, Oct. 28, 1955, excerpted in 2 ATOMIC INDUSTRIAL FORUM MEMO 5 (Nov. 1955).

THE STATE OF DEMOCRATIC CONTROLS

Atomic power presents the usual spate of issues for public policy. These bring into account the many objectives which American Government must simultaneously pursue. Decisions are required which necessarily make compromises between conflicting ends. Thus, specifically, if we take the road to maximum military use of atomic power, we may not be in a good position in the international rivalry of propaganda; but if we take the road of maximum civilian power, the military program could suffer from lack of technicians. If we subsidize private enterprise too greatly, industry will not have the incentive to develop competitive economic power; but if we fail to subsidize enough, our development may lag. If we keep down the government share by favoring those firms which can pay a larger share of the developmental expenses, we run the risk of allowing a few companies to fill the field; but if we insist upon equal access, we must hold back progress toward practical power. If we permit free development, we may suffer from the exacerbated hardships of technological change; but if we plan to soften the latter, we may slow the rate of economic progress. If we favor public power, we weaken private incentive; but if we favor private power, we lose the strength of the existing price yardstick.

American democracy prides itself on automatic balance-wheels and adjusters which prevent the adoption of extreme policies. The watchdog Joint Committee on Atomic Energy, the General Advisory Committee, and the Military Liaison Committee are such in the governmental structure itself. But an active interplay of influences involving persons and groups outside the Government is also essential for the best operation of these balance-wheels.

Hence, the proliferation of interests centering about the field of atomic power is healthy for American democratic control. Fortunately, the contending forces are so strong and the vested interests so large that no comprehensive settlement of "policy" in favor of one group or another can take place. And this is as it should be in a vital democratic society.

THE PUBLIC INVESTMENT IN ATOMIC POWER DEVELOPMENT

RICHARD A. TYBOUT*

From the outset, the development of commercial atomic power has been a statutory responsibility of the United States Atomic Energy Commission. For the first seven years of its existence, the Commission operated under a declaration of policy which emphasized the development and utilization of atomic energy to improve the public welfare and increase the standard of living, with prior concern only for national security.[1] Five programs were prescribed in the organic legislation of 1946, the first three of which directed the Commission to assist research and development and the dissemination of information to encourage scientific progress. Medical, agricultural, and industrial progress were envisaged.[2] The framework for acquisition of basic facts on matters of peaceable interest was clearly established. And specific provisions were included to bring industrial applications to the attention of Congress when their social effects could be more accurately assessed.[3]

Operating under the 1946 legislation, the Atomic Energy Commission rose to second place among federal agencies with respect to expenditures upon research and development, a position which it continues to hold. In fiscal year 1953, the AEC obligated expenditures of $204 million for this purpose.[4] The Department of Defense held a clear first place with obligated expenditures of $1.48 billion out of the total federal budget allocation of approximately $1.92 billion, while the Department of Agriculture held a lagging third place with $56 million. All research and development expenditures for all purposes are included—defense expenditures for military purposes, agricultural expenditures for peaceful aims, and atomic energy expenditures on a middle ground oriented toward both military and peaceful objectives. Although a mainstay in our defense efforts, atomic energy development has been conducted in accordance with a relatively new and commendable idea—that is, to develop at public initiative, from defense technologies, such commercial and peaceful applications as hold reasonable promise of improving the standard of living.

Commercial (and military) applications are the end products of a series of research activities of increasing specificity. At the earliest and most general level is basic

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[1] 60 STAT. 755, 42 U.S.C. §1801 (1946).

[2] See *Report on Atomic Energy Act of 1946*, S. REP. No. 1211, 79th Cong., 2d Sess. (1946).

[3] 60 STAT. 764, 42 U.S.C. §1807(b) (1946).

[4] NATIONAL SCIENCE FOUNDATION, 3 FEDERAL FUNDS FOR SCIENCE, *Selected Analyses of the Current Budget*, pt. 2, at 4 (1954). This source does not include single nonrecurring items, such as laboratory or other installations, because they suggest sizable fluctuations in research programs which, in fact, do not occur.

research, the main objective of which is simply to learn the laws of nature. Next is applied research, which seeks to apply natural laws to the solution of practical problems, commercial or otherwise. If sufficiently promising solutions are found in the laboratory, experimentation is carried into model plants called pilot plants. This stage, known as development, shifts the research emphasis from the scientific to engineering problems. Finally, full-scale production installations are built, and in the process of operating these, further knowledge is gained.

Research and development that contributes to economic atomic power has proceeded at the first two levels since the Commission assumed responsibility for the atomic energy program in 1947 and had been conducted for years before that time. Developmental work upon reactors evolved under the AEC, at first jointly for military and civil objectives, and more recently for these categories separately. Now, we have reached the stage of building a full-scale atomic power station for the generation of electricity. In the course of research and development at all levels, which is continuing apace upon problems related to and unrelated to atomic power, the Commission has tapped a wide range of academic fields—physics, chemistry, metallurgy, engineering, biology, and medicine—to name only the most popular. Numerous individual scholars throughout the country hold AEC research contracts. University projects financed by contracts with the Commission play a key part. Extensive integrated research programs are conducted at the three National Laboratories,[5] at the National Reactor Testing Stations,[6] and at many other AEC and private laboratories operated by industrial concerns under contract.

From January 1, 1947 through fiscal year 1955, the Commission obligated expenditures of $660 million upon its basic and applied research programs—approximately $220 million for biology and medicine, and $440 million for physical research.[7] Much of the knowledge gained in both areas has been necessary for atomic power and will undoubtedly continue to contribute to atomic power progress, but no allocations of cost can be made to atomic power. The purpose in obligating these expenditures was too general. Moreover, the Commission's physical science and biology and medicine programs partake sufficiently of broad educational objectives to be properly charged against the government responsibility in this area, though this view must be qualified by the fact that in fiscal year 1953, the Commission's obligations incurred for physical research and biology and medicine were twenty-seven times those incurred by the National Science Foundation,[8] a federal agency created

[5] Argonne (Cook County, Ill.); Brookhaven (Long Island, N.Y.); and Oak Ridge (Tenn.).

[6] Located at Arco, Idaho.

[7] These figures are calculated from obligations reported in annual appropriations requests of the AEC. They include operating expenditures and plant and equipment expenditures. Some of the latter, of course, are for facilities that will continue to be used in future years. The figures are totals of actual obligations incurred, except for operating expenses in 1955 and plant and equipment expenses in 1954, which are year-end estimates, and plant and equipment expenses in 1955, which are forecasts.

[8] Actual obligations of the National Science Foundation, including both operating expenses and plant and equipment expenditures, are given in NATIONAL SCIENCE FOUNDATION, 3 FEDERAL FUNDS FOR SCIENCE, *op. cit. supra* note 4, at 21. Actual obligations for the two programs of the Atomic Energy Commission are given in *Hearings before the Subcommittee of the House Committee on Appropriations on Independent Offices Appropriation for 1955*, 83d Cong., 2d Sess., pt. 3, at 2511, 2518 (1954).

solely for the purpose of giving public assistance to and promoting basic research in all of the sciences not otherwise supported.[9]

With the progress of science in atomic technology came statutory revision. In 1954, public responsibility for the development of commercial atomic power was made more pointed. The statutory declaration in the sweeping amendments which constitute the Atomic Energy Act of 1954 gives new emphasis to peaceful applications by proclaiming them in its first sentence and by its ordering of national objectives.[10] Six programs are prescribed, the first two of which roughly parallel the 1946 programs for assistance of research and development, except that in the 1954 legislation, they are to encourage "scientific *and industrial* progress,"[11] rather than, as previously, the former by itself. Furthermore, a third of the six programs prescribes, to the extent consistent with national defense and public health and safety, encouragement of widespread participation in the development and utilization of atomic energy for peaceful purposes. The shift in emphasis is clear. A continuity of public policy for the assistance of peaceable research and development has brought commercial applications near fruition, and public assistance is now being carried into the industrial area itself.

REACTOR DEVELOPMENT COSTS

Nuclear reactors serve both military and civil purposes. From the standpoint of our present interests, they, of course, provide heat from which electric power is generated. In their military role, they furnish the same heat, from which electric power or mechanical power can be obtained for the propulsion of submarines, aircraft, or for other military purposes. Also of military importance is the fact that nuclear reactors somewhat different technologically from power-producing reactors are used for the production of fissionable materials for atomic weapons and in the production of other materials for hydrogen bombs.

Reactor development costs representing these different ends are shown in Table I for the Atomic Energy Commission's activities from January 1, 1947 through June 30, 1955 and for activities in which the Commission has a public commitment through June 30, 1958. Three purposes are classified: civil electric power, military power, and general. Some reactor development costs for production of fissionable and other materials are included in the Table I figures, but to the extent that they are included, they are appropriately assigned to one of the three power categories. Costs shown in each of the first two categories are so classified because they are explicitly recognized by the Commission for one or the other purpose and are budgeted accordingly in AEC accounts. General reactor development costs are not assigned by the Commission to civil or military power, but are assigned jointly to both.

No attempt is made to anticipate whether the developmental costs incurred for

[9] 64 STAT. 149 (1950), 42 U.S.C. §1862 (Supp. 1952).
[10] 68 STAT. 919, 42 U.S.C.A. §2011 (Supp. 1954).
[11] 68 STAT. 922, 42 U.S.C.A. §2013 (Supp. 1954) (emphasis added).

TABLE I

ATOMIC ENERGY COMMISSION REACTOR DEVELOPMENT COSTS
(In Millions of Dollars)

Purpose	Costs Through Fiscal Year 1955					Projected Costs Through Fiscal Year 1958			
	(1) Operating	(2) Plant and Equipment	(3) Total	(4a) Total Civil Power Costs	(4b)	(5) Operating	(6) Plant and Equipment	(7) Total	(8) Total Civil Power Investment
Civil Power Reactors									
Pressurized Water Reactor	17.2	6.6	23.8			45.0	40.0	85.0	
Advanced Water Reactor	9.0	0.8	9.8			16.0	1.0	17.0	
Homogeneous Reactor	21.3	1.0	22.3			35.1	11.9	47.0	
Fast Power Breeder Reactor	9.1	4.1	13.2			22.3	17.7	40.0	
Sodium-Graphite Reactor	5.4	—	5.4			9.5	0.5	10.0	
Other	3.9	0.3	4.2			42.5	—	42.5	
Total Civil Power	65.9	12.8	78.7	78.7	78.7	170.4	71.1	241.5	241.5
Public Information Program	1.8	—	1.8	1.8	1.8	—	—	—	—
Acceleration of Civil Power	—	—	—	—	—	50.0	25.0	75.0	75.0
Military and Classified Projects	237.6	131.4	369.0			—	—	—	—
				Prorated	Alternative Cost Avoidance				
General Development, Operation of Supporting Facilities, etc.	162.3	181.2	343.5	74.8	171.8	—	—	—	—
Total Reactor Development	467.6	325.4	793.0	155.3	252.3	—	—	—	—

SOURCE: Columns (1), (2), and (3) show unpublished data from U. S. Atomic Energy Commission. The Public Information Program was estimated at $300,000 per year for five years preceding June 30, 1955, plus $334,000 for services given industry groups. General Development costs includes 3.5 per cent of all other operating costs for administration of all reactor development activities. Data on Civil Power Reactors listed in columns (5), (6), and (7) are from the combined sources: JOINT COMMITTEE ON ATOMIC ENERGY, REPORT OF THE SUBCOMMITTEE ON RESEARCH AND DEVELOPMENT ON THE FIVE-YEAR POWER REACTOR DEVELOPMENT PROGRAM PROPOSED BY THE ATOMIC ENERGY COMMISSION, 83d Cong., 2d Sess. (1954); and *Hearings before the Joint Committee on Atomic Energy on Development, Growth, and State of the Atomic Energy Industry*, 84th Cong., 1st Sess. 145 (1955). The costs for Acceleration of Civil Power were approved by H. R. 6766, Public Works Appropriation Act, 1955, c. 370, 69 STAT. 354 (1955), and H. R. 7278, Supplemental Appropriation Act, 1956, c. 541, 69 STAT. 450 (1955).

Costs are given on an accrual basis. This means that plant and equipment costs appear only to the extent depreciation is charged and that all other costs are similarly unrelated to the time of corresponding cash disbursements.

civil power will also serve military purposes or vice versa. The important point in evaluating the public investment in civil atomic power development is the purpose for which the costs were incurred. It is common knowledge that many defense programs have given rise to commercial applications. Examples come to mind in the electronics industry, in Diesel engines, and elsewhere. In our approach, these are social windfalls, since the research and development out of which they grew was undertaken solely for defense. By contrast, the Atomic Energy Commission operates under terms of reference, as we have seen, that make clear the dual purpose of its research and development.

The first five reactor projects in Table I represent the five prongs of the Commission's current Five-Year Power Reactor Development Program, commonly known as the five-year program. This program includes four pilot plant projects. The fifth project is a full-scale power station, the pressurized water reactor, to be operated by the Duquesne Light Company, of Pittsburgh, under a cost-sharing agreement with the Atomic Energy Commission, which agreement we shall examine in greater

detail later. Costs incurred by the Duquesne Light Company, of course, are not included in Table I.

The five-year program was formally announced in March, 1954,[12] although AEC research and development had built up to it in projects undertaken prior to that time. The pressurized water reactor was the natural successor to work that had been done by the Westinghouse Electric Corporation in the Commission's Bettis Laboratory at Pittsburgh, although the work had been as much for military as for civil purposes; and Westinghouse is the Commission's principal contractor for the design, development, and construction of the reactor portion of the plant. The advanced water reactor concept was initiated by Argonne National Laboratory, operated for the Commission by the University of Chicago; and the present project is the third of a series employing the same principle conducted by the Chicago group at the National Reactor Testing Station. A small model of the homogeneous reactor was started in March 1951 at the Oak Ridge National Laboratory, operated for the Commission by the Union Carbide and Carbon Corporation, and was shut down and dismantled in early 1954; and the present homogeneous reactor is also being constructed at Oak Ridge. The fast power breeder reactor, like the advanced water reactor, is being designed under the direction of the University of Chicago at the National Reactor Testing Station and follows a previous model designed and operated by the University at the National Reactor Testing Station. The sodium-graphite reactor is being designed and will be operated by North American Aviation, Inc., at a location near Los Angeles. Experiments with the sodium-graphite technology have previously been conducted by North American Aviation and have grown out of other work involving a submarine reactor at the Knolls Atomic Power Laboratory in Schenectady, owned by the AEC and operated by the General Electric Company.

The cost of earlier research and development leading up to the five reactors are assigned in Commission accounts, which were the source of data in Table I, to civil atomic power only in cases where this was the clear intention at the beginning of the research. In all of the projects except the pressurized water reactor, costs incurred before fiscal year 1954 are included in cumulative totals as of the end of fiscal year 1955. Otherwise, earlier costs are included under the general or military headings, whichever is appropriate. The "Other" item in "Civil Power Reactors" shows developmental costs that are peculiar to civil power, but not to any one of the five reactor projects.

Included with the civil power reactors are the AEC public information programs directed toward the dissemination of technological information for civil atomic power and a new program, Acceleration of Civil Power, beginning in fiscal year

[12] See Joint Committee on Atomic Energy, *Report of the Subcommittee on Research and Development on the Five-Year Power Reactor Development Program Proposed by the Atomic Energy Commission*, 83d Cong., 2d Sess. (1954). Progress under the program was more recently reported in Joint Committee on Atomic Energy, *Current Statement of the Atomic Energy Commission on the Five-Year Reactor Development Program to the Subcommittee on Research and Development*, 84th Cong., 1st Sess. (1955).

1956. The public information programs include exhibits, publication aids, and services rendered by the Atomic Energy Commission in its now-terminating Industry Study Program. The latter involved an AEC cost of $344,000 and a private cost of $4.9 million to bring industry groups into contact with classified reactor development data.[13] The acceleration program is to furnish public aid to privately proposed atomic power stations in ways that we shall note in future discussion.

The military projects to which Table I refers include, as we have seen, the development of atomic propulsion engines for submarines, naval surface vessels, and aircraft. For such uses, atomic energy offers the military advantages of a fuel that needs no replacement for years at a time. More recently, military interest has included the small "package" electric power plant operated by nuclear energy, which can be set up at remote installations—again, without the traditional logistic problems of refueling.

The general costs shown in Table I include the administration of reactor development for all purposes shown in the table; the operation of the National Reactor Testing Station, with its chemical processing and other service facilities; and a long list of advanced engineering studies of heat exchangers, compressors, valves, pumps, materials corrosion, and like matters related to the operation of power reactors. Much of the work done in early years fits neither of the other two classifications and hence appears among the general costs.

Table I shows general costs assigned to civil and military objectives by two procedures. These procedures make alternative assumptions and follow what seem to be the most applicable theories of common cost allocation for present purposes. In the first procedure, general costs have been prorated in proportion to the operating costs of civil reactor development as a percentage of the combined total operating costs of civil and military reactor development. This method treats general costs in the same way in which overhead burden is treated in many industrial cost accounting systems. In the case at hand, it assumes that the operating costs for civil atomic power development reflect the proportion in which general costs are incurred for the same purpose. This approach places general costs assignable to civil reactor development at $74.8 million and the total civil power cost to June 30, 1955 at $155.3 million.

The second procedure views all costs incurred in civil reactor development, whether for operating expenses or plant and equipment, as capital investments. This view seems well suited for the general nature of research and development. General costs under this procedure, then, are regarded in much the same way as are capital costs for some of our large multi-purpose river and regional development projects, such as the Tennessee Valley Authority. On this basis, we have adopted the most satisfactory of the techniques used for allocation of multi-purpose investment costs, the "alternative cost avoidance" principle.[14]

[13] See the testimony of Dr. Willard F. Libby, member of the AEC, in *Hearings before the Joint Committee on Atomic Energy on Development, Growth, and State of the Atomic Energy Industry*, 84th Cong., 1st Sess. 12 (1955).

[14] For an extensive discussion of the methods and problems of common cost investment allocations, see JOSEPH S. RANSMEIER, THE TENNESSEE VALLEY AUTHORITY 270-75 (1942).

As applied to general reactor development costs, alternative cost avoidance recognizes savings for both military and civil purposes in the concurrent conduct of research for both. If conducted independently, each would have to incur at least some of the general costs listed in Table I. Therefore, we ask how much of these general costs each is avoiding because of the concurrent conduct of the other. The alternative cost avoidance principle assigns general costs to each purpose in proportion to the costs that purpose is avoiding.

As if to answer our question, Dr. L. R. Hafstad, Director, Division of Reactor Development, stated in 1952:[15]

> For the immediate future, very little distinction can be made between reactors for civilian uses and reactors for military uses. In general, the same ground must be covered in order to learn how to design a power-producing reactor for any purpose.

The same is true of the costs incurred by the Atomic Energy Commission since 1952, in so far as these are classified as general.[16] This being the case, the costs avoided by each of the purposes are equal—military and civil power have shared alike in the general costs. The alternative cost avoidance principle, therefore, assigns $171.8 million, or half the general costs, to civil reactor development, giving a total civil power cost to June 30, 1955 of $252.3 million.

Also shown in Table I are costs projected by the Atomic Energy Commission through fiscal year 1958. The costs given for the five-year program reactor projects are quite firm as a result of their approval, on March 23, 1954, by the Joint Committee on Atomic Energy.[17] The costs shown for the acceleration program are from appropriations that have already been authorized, the $50 million for operating expenses[18] and the $25 million for plant and equipment.[19] The Commission has estimated that acceleration program operating costs to be incurred in fiscal year 1956 will be $10 million, the balance of the $50 million to be included in unpaid obligations at the end of the fiscal year.[20] There is no doubt that the total of operating costs will be incurred by the end of fiscal year 1958, but it seems unlikely that all of the $25 million for acceleration program plant and equipment will appear as cost before the end of fiscal year 1958. It is all included in the Table I projected figures, however, in the absence of any more exact information and since it is committed ultimately to civil power in any event.

Figures representing commitments with anything like the assurance of those given for civil power are not available for military and general reactor projects through fiscal year 1958, nor are such figures available for related public information costs. Impossibly low, irreducible minima for the public investment in civil atomic power

[15] *Hearings before the Subcommittee of the Senate Committee on Appropriations on H.R. 7072, Independent Offices Appropriations, 1953*, 82d Cong., 2d Sess. 52 (1952).

[16] Personal communication, Atomic Energy Commission, July 26, 1955.

[17] See *Report, supra* note 12, at 4.

[18] 69 STAT. 354 (1955).

[19] 69 STAT. 450 (1955).

[20] See prepared statement by the AEC, in *Hearings before the Subcommittee of the House Committee on Appropriations on Public Works Appropriations for 1956*, 84th Cong., 1st Sess. 391 (1955).

could be obtained by adding to the 1958 figures the general reactor and public information costs as these stood at the end of fiscal year 1955. This would give a public investment ranging from $393.1 to $490.1 million, but ignores the obvious fact that general costs attributable to civil power are being and will continue to be incurred beyond June 30, 1955. Moreover, we cannot exclude the possibility that another acceleration appropriation might be made before the end of fiscal year 1958.

An alternative approach is to assume that military and general reactor costs will continue at the same rate over the next three fiscal years as they have averaged over the eight and a half years of the Commission's life ended on June 30, 1955. All indications are that this will understate the actual costs, because so little was done in early years and because there has been a continuous accelerating of reactor development in recent years. This approach gives a public investment of $507 to $551 million, which, in view of the conservative assumptions we have made, will probably turn out to be quite low. Rounding the figures and increasing the spread to allow for uncertainties and to offset somewhat the conservative bias, we will settle upon the range $500 to $600 million as a working estimate of the AEC investment in civil atomic power development by the end of June 1958.

THE DECADE OF DEVELOPMENT: 1958-1968

The Atomic Energy Commission intends that the five-year program and other efforts through fiscal year 1958 will serve as important ground-breakers, but it does not feel that they will go all the way to bring competitive nuclear power. Statements of goals in civil development generally refer to nuclear power as becoming competitive at some period in time quite a few years after 1958. In July 1954, Dr. Hafstad stated:[21]

> Those of us in the atomic energy business feel that the cross-over point [between conventional and nuclear power costs] is likely to come somewhere between five and fifteen years from now, depending on the vigor and intensity of the development effort in the atomic energy field.

This would place the point at which civil atomic power becomes competitive with conventional power between 1959 and 1969, suggesting a most probable year of 1964. Dr. Hafstad again spoke on this subject in October 1954, while discussing the depletion of national energy resources as a cause for atomic power development:[22]

> Now, since uranium is potentially attractive as a fuel for powerplants, we have projected that within the next decade or two, a small but increasing percentage of the new central station powerplants might be nuclear. This might well happen when the pressure on oil and gas forces the liquifaction and gassification of coal.

[21] Remarks prepared by Lawrence R. Hafstad, Director, Division of Reactor Development, AEC, for Delivery before the Missouri Basin Inter-Agency Committee, Rapid City, S.D., AEC Release, July 21, 1954.

[22] Remarks prepared by Lawrence R. Hafstad, Director, Division of Reactor Development, AEC, to the Electric Companies Public Information Program Annual Workshop Conference, St. Louis, Mo., AEC Release, Oct. 28, 1954.

Dr. Hafstad referred to expert opinion which dated the point when oil and gas are expected to begin to be unable to meet the demand for liquid fuels at about the year 1970.[23] This suggests that the competitive level envisaged by Dr. Hafstad might come late rather than early in the 1960's. Further substantiation of a late date is found in a statement by Dr. James A. Lane, of the Oak Ridge National Laboratory, at the seventy-two nation Atoms-for-Peace Conference in Geneva in August 1955, to the effect that atomic power will become competitive with conventional power within the next 15 to 20 years in the United States.[24] If we seek a compromise date, even an early one out of deference to Dr. Hafstad's authority, it appears that there will pass at least a decade after 1958 before atomic power costs, by and large, become as low as electric power costs in conventional installations.

The magnitude of the research and development job yet to be done is suggested in a recent statement by W. Kenneth Davis, Director, Division of Reactor Development (Mr. Davis assumed this post in February 1955, three months after Dr. Hafstad requested a release from his AEC assignment to accept a position in private industry):[25]

> Taking everything into account, I believe it is fair to say that we do not know *today* how to build a nuclear power plant which would produce power for much less than two to three times that from the best conventional plant of the same size which could be built instead.

In a previous address, in October 1954, Mr. Davis had placed the cost of nuclear power at approximately three times that of conventional power.[26] In both addresses, Mr. Davis pointed out that his estimates were for nuclear plants whose construction might start at that time, but whose date of completion would be several years later—in 1958 or 1959.

Atomic Power Stations and AEC Research Assistance

For the decade of development from 1958 to 1968, the Atomic Energy Commission has been concerned almost exclusively with the construction of full-scale atomic power stations, suggesting that AEC has tentatively cast around them its plans for progress. Public utility investments in atomic power appear to have been first urged by Dr. Hafstad in July, 1954:[27]

> Utility organizations, for the sake of their own education and as a contribution to the national good, should be persuaded to consider seriously substituting a few nuclear power

[23] There are differences of opinion among experts on this point. See generally 3 PRESIDENT'S MATERIALS POLICY COMMISSION, RESOURCES FOR FREEDOM (1952), in which many developments that would tend to keep down real fuel costs through 1975 are discussed.

[24] See Wall Street Journal, Aug. 10, 1955, p. 1, col. 3.

[25] Remarks prepared by W. Kenneth Davis, Director, Division of Reactor Development, AEC, for Presentation at the Seventeenth Annual Meeting of the American Power Conference, Chicago, Ill., AEC Release, April 1, 1955.

[26] See remarks prepared by W. Kenneth Davis, Deputy Director, Division of Reactor Development, AEC, for Presentation at the National Industrial Conference Board, New York, N. Y., AEC Release, Oct. 13, 1954.

[27] Remarks prepared by Lawrence R. Hafstad, *supra* note 21.

plants for conventional plants in the course of normal expansion. . . . The nuclear plant will cost significantly more than a conventional plant. . . . Since the utilities' first responsibility is to the customer, the higher cost of such a nuclear plant cannot strictly be justified, though the cost of the equivalent conventional plan will represent a routine expenditure. . . .

A joint program might, therefore, be developed on this basis: As a first approximation the utility company proposes to provide an amount of money equal to the cost of a conventional plant for the location in question while the Atomic Energy Commission, as part of its research and development expense, finances the difference between the cost of a conventional plant and a nuclear plant.

Dr. Hafstad's joint program would increase the AEC (public) investment in atomic power development but would protect the consumer and alleviate the necessity for private capital investment in the foreseeable future of high-cost atomic power. Apparently attempting to enlist private capital investment, Dr. Hafstad told an industrial audience in September 1954, three months later:[28]

The time has just about passed for industry, especially companies new to the business, to come in to Washington and get large contracts with Government money and thus learn the atomic business. Anything over and above the five-year program as it is now planned will essentially be the responsibility of industry and must be carried out with industrial money.

Later in the same address, he amplified the point:[29]

I think you utility people ought to come in with a proposal which shows competence, genuine interest, and real determination to carry through and learn from your experience with the new plants. There will be ways and means under the new law for the Government to help you over the hurdles and get the plants built.

In view of a subsequent statement by Mr. Davis, it seems likely that Dr. Hafstad's "ways and means" referred especially to AEC financial assistance in the conduct of research and development on tough technological problems. This is exactly what the Commission's five-year program and its acceleration program seek to accomplish, as explained by Mr. Davis in his April 1955 address:[30]

The important matter is to make sure that we have done all we can to reinforce the technical basis for a nuclear power industry and to provide an atmosphere in which it can take root and grow. . . .

The Atomic Energy Commission can be of considerable help in developing the basic technology and this, in fact, is the objective of the Commission's present program.

One is naturally led to ask whether public expenditures for commercial goals are indeed good public investments if made for projects which private industry will not support with its own funds. A number of points can be made in the affirmative.

[28] Remarks prepared by Lawrence R. Hafstad, Director, Division of Reactor Development, AEC to the Conference of the Atomic Industrial Forum, Inc., on *The New Atomic Energy Law—What It Means to Industry*, New York, N. Y., AEC Release, Sept. 28, 1954.

[29] *Ibid.*

[30] Remarks prepared by W. Kenneth Davis, *supra* note 25.

Assuming that a dollar spent on research by the Government yields the same technological results as a dollar spent on research by private industry, the former may represent a broad enough public interest in economic progress to be written off, so to speak, from resulting public benefits[31] in circumstances where the latter would not be able to be written off in the patentable value of the results.[32] Nonpatentable results, for example, would seem to offer no incentive for private financing of research, though we know that a certain small part of industrial research is in basic science, where the results are not patentable. The same lack of private incentive would appear to exist in research whose results are not expected to pay off except over a term longer than the duration of patent rights, or in research whose results overlap many industrial fields so that no single individual firm would sufficiently participate in the fruits of a research investment to make it pay. All of these considerations—nonpatentabilty, length of time before profitable application, and breadth of industrial consequences—apply particularly to the atomic power field and would justify a public effort in research and development.[33]

On the negative side of the case for public support of research and development are the difficulties of moving from the public sector to the private sector of the economy, with research and development being conducted in the former and the results employed in the latter. If private enterprise is to have free access to the research results, these results should be equally available to all. This would present difficult problems in the dissemination of information and in the education of industrial groups under any circumstances. As has been shown elsewhere, the problems are particularly aggravated in the atomic energy program by the contractual arrangements which it is necessary for the AEC to make to achieve its other goal of efficient production of special nuclear materials for national defense.[34] The tendency, which the Commission would find difficult to offset if it had ample time and impossible to offset if civil atomic power is pushed into the private sector with maximum speed, is for contractors and others having an early part in work conducted at public expense to gain special advantages that will prejudice their less fortunate industrial rivals. If the public support of research and development gives special aid to certain private groups and thereby increases industrial concentration, this is a clear point in its condemnation, though we note, on balance, that privately conducted research and development, too, is often associated with industrial size and the perpetuation of industrial concentration.[35]

[31] Exactly what is involved in writing off a public expenditure will be illustrated in a later calculation for the public investment in civil atomic power development.

[32] It is assumed that the results of publicly financed research and development would be made generally available for private use, whether with or without a publicly owned patent. If a patent were publicly owned, this would mean that it would be made available on a nonexclusive royalty-free basis.

[33] Special rules apply for atomic energy patents, but it is not felt that these change the broad points made here. The patent problem in atomic energy is treated in another article in this symposium. See Boskey, *Some Patent Aspects of Atomic Power Development, infra,* 113-31.

[34] See Tybout, *The Contractor System,* 290 ANNALS 82 (Nov. 1953). The point is developed in detail in a forthcoming book, RICHARD A. TYBOUT, GOVERNMENT CONTRACTING IN ATOMIC ENERGY.

[35] This, of course, is the point usually associated with the late Joseph A. Schumpeter. See JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM, AND DEMOCRACY c. 8 (2d ed. 1947).

To summarize, then, it appears that there are many advantages inherent in the public conduct of research and development and that the problems which it entails, though serious, especially in the atomic energy case, are problems of administration that are not insurmountable.

Rate of Growth of the Nuclear Power Industry

Some indication of the magnitude of the expected investment in atomic power facilities was given by Mr. Davis in April 1955. Mr. Davis' estimates appear in Table II under his name. He explained his approach in making the estimates as follows:[36]

> In my view, we can look forward to three phases in the transition to nuclear power plants. . . . During the first or "induction phase," it is anticipated that some fairly large nuclear plants will be built, largely with private funds. The Government will lend fissionable material and may finance laboratory research and development, and possibly pay for technical information resulting from development, construction, and operation of the plants.
>
> At some point in time the degree of confidence in the eventual economic advantages of nuclear power will become so strong that a relatively large proportion of new power plants will be nuclear. This will be largely a psychological point. However, when it is reached it is not difficult to foresee the proportion of nuclear power plants to the total number being built increasing from perhaps 5 percent to 60 percent in 10 years or less. Once this trend is started, the very fact of the transition itself will contribute enormously to solution of economic problems.
>
> When the proportion of new nuclear plants reaches perhaps 60 to 70 percent, the growth may become a matter of slow saturation, since at that point the rest of new capacity will be either in very small plants or in plants located where fuel costs are exceptionally low.

The three financial aids to which Mr. Davis refers in his first paragraph are made available from appropriations in the previously noted acceleration program and constitute an important feature of AEC's current Power Demonstration Reactor Program, hereinafter called the demonstration program, in aid of atomic power stations otherwise privately financed. The two aids in the form of government-financed laboratory research and development and government payments for research and development results fit the general analysis which we have completed in immediately preceding paragraphs. The government lending of fissionable materials is a different type of public aid which draws upon AEC costs budgeted outside of Table I and will be discussed in connection with the broader topic of AEC charges and price supports.

In his second paragraph, Mr. Davis does not base the transition to nuclear power plants upon expected cost advantages, but, on the contrary, feels that cost reductions will follow as a consequence of what seems to be an expected band-wagon movement. He does not seem to contemplate public aids in the swing to nuclear plants, though in a chart presented with his remarks, he places the beginning of the up-

[36] Remarks prepared by W. Kenneth Davis, *supra* note 25.

swing in 1965 and the leveling off in 1975. In his third paragraph, Mr. Davis clearly indicates that, in his view, nuclear power will have become competitive in a large sector of the economy by the time of leveling off, or 1975. These predictions are roughly consistent with our previously selected 1968 date for generally competitive nuclear power. They are surprising, however, in the extent to which they seem to suggest a large investment in nuclear power before this date.

Accompanying his estimates of nuclear power capacity shown in Table II, Mr. Davis gave an estimate of 200 million installed kilowatts for total national electric generating capacity in 1965 and 400 million in 1975. Comparing Table II, this would mean that he expects 2½ per cent of total electric generating capacity to be nuclear in 1965 and approximately 21 per cent to be nuclear in 1975. By way of comparison, the President's Materials Policy (Paley) Commission estimated 300 million kilowatts of generating capacity will be required in 1975,[37] the Federal Power Commission has placed the figure at roughly 250 million kilowatts,[38] and the Edison Electric Institute forecasts a range of 301 to 423 million kilowatts.[39]

Mr. Davis acknowledged optimism at the time that he gave his estimates of both nuclear and total power generating capacities. In view of both this fact and the additional fact that we shall later find grounds to doubt whether such a large part of total national generating capacity can be in nuclear power plants in the years before nuclear power becomes competitive with conventional power, we have calculated

TABLE II

INSTALLATION OF ATOMIC POWER GENERATING FACILITIES

Year	INSTALLED ATOMIC POWER CAPACITY, MILLIONS OF KILOWATTS	
	Davis Estimates	FPC-Lane Estimates
1960	2	0.5
1965	5	5.0
1970	27	12.0
1975	83	20.5
1980	175	31.5
1985	...	45.0
1990	...	61.0
1995	...	79.5
2000	...	100.5

SOURCE: Davis estimates are from Remarks by W. Kenneth Davis, Director, Division of Reactor Development, at the Seventeenth Annual Meeting of the American Power Conference, Chicago, Ill., AEC Press Release, April 1, 1955. Mr. Davis' estimates are for the year's end in each case.

FPC-Lane estimates were calculated from two sources. Yearly peak load estimates given by FPC, ESTIMATED FUTURE POWER REQUIREMENTS OF THE UNITED STATES BY REGIONS, 1953-1975, 2 (1954) were used to determine the new generating capacity installed each year. The FPC reported estimates through 1975 only. Beyond that date, total generating capacity was estimated by extrapolation of FPC figures. Estimates of the proportions of new capacity expected to be in atomic power stations were then obtained from Lane, *Growth Potential of the U. S. Nuclear Power Industry*, Nucleonics, June 1954, p. 15, and new atomic power installed each year was calculated, from which the total atomic power capacity in each year was determined. Dr. Lane's estimates were given through year 2000 A.D.

[37] See 3 PRESIDENT'S MATERIALS POLICY COMMISSION, *op. cit. supra* note 23, at 32.

[38] See FPC, ESTIMATED FUTURE POWER REQUIREMENTS OF THE UNITED STATES BY REGIONS, 1953-1975, at 2 (1954).

[39] See EDISON ELECTRICAL INSTITUTE, LOOKING AHEAD TO THE LAST QUARTER OF THE FIRST CENTURY OF ELECTRIC POWER 7 (1954).

conservative estimates of future nuclear power capacity, also shown in Table II. These estimates appear under the caption "FPC-Lane," for they draw from Federal Power Commission estimates combined with estimates by Dr. James A. Lane, Oak Ridge scientist.

AEC Charges and Price Supports

We have noted Mr. Davis' statement that the Commission will consider lending special nuclear (fissionable) materials to private power plants. As presented in the AEC demonstration program, the waiver of charges refers only to the interest charges and not to the cost of nuclear fuel produced at public expense and consumed by private power plants.[40] Moreover, the law requires that for nuclear fuels consumed in commercial (but not research) facilities, the Commission must make a charge equal to either the cost (presumably total unit cost) of the nuclear fuels which it has produced or the average price it has paid others to produce them, whichever is the lower.[41] This, of course, does not prevent the Commission from classifying early nuclear power stations as research rather than commercial facilities—which it is doing—but lends support to the expectation that undercharging for fuel elements will not be an important form of public aid.[41a] In the same vein, the Commission has agreed to furnish services of fuel element fabrication, chemical recovery of spent fuels, and other refining or processing operations at charges estimated separately for each job on the basis of recovery of full costs.[42]

Public aids have long been debated at the other end of power production, too—in connection with the Commission's buying back of nuclear fuels produced in private nuclear power plants. It is a well-known technological fact that plutonium, and perhaps the uranium isotope (U-233), will be produced in power plants at the same time that electricity is produced and at the same time that these or other fissionable materials are being consumed.[43] Early attention, therefore, settled upon the concept of a "dual-purpose" reactor, which would produce both electricity and fissionable materials, the latter to be priced with reference to their value for weapons.[44] An opposing school advanced the "single-purpose" reactor, whose virtue lay in the fact that fissionable materials produced as by-products of power genera-

[40] See AEC Release No. 589, Jan. 10, 1955.

[41] 68 STAT. 930, 931, 42 U.S.C.A. §§2072, 2074 (Supp. 1954).

[41a] As this article goes to press, it appears that the above expectation must be qualified. In remarks prepared for presentation before the Iowa Utilities Association, Des Moines, Ia., AEC Release, Oct. 10, 1955, W. Kenneth Davis, Director, Division of Reactor Development, AEC, stated: "The established prices [at which the Commission will lease fuel for reactors] were arrived at to reflect as well as possible the long-run true value of the materials purchased. Since the AEC is presently manufacturing some of these materials, prices were set to represent the savings in dollar expenditures by the Commission if the materials were produced by industry and purchased by the AEC, rather than if they were produced by the AEC." This means that until fuel materials are acquired by the AEC at the expected lower prices, public aid will result from this method of pricing the leased fuels.

[42] See the prepared statement read into the record by Kenneth D. Nichols, General Manager, AEC, in *Hearings, supra* note 13, pt. 1, at 74-75.

[43] If nuclear fuels are being replaced more rapidly than they are being consumed in this process, we have what is known as "breeding."

[44] See Cisler, *Economic Feasibility: The Dual Purpose Reactor*, 290 ANNALS 45 (Nov. 1953).

tion would be priced only with reference to their value as fuel in further power generation (and further creation of replacement fuels).[45]

The AEC has expressed itself in favor of the single-purpose-reactor approach. The reasons, as given by W. Kenneth Davis, are twofold.[46] The AEC takes the position that for the long-term future, it is best to conceive a civil atomic power industry not dependent, in any degree, upon military demands.[47] Second, the AEC is committed to the single-purpose approach, as explained by Mr. Davis, because technologically a single-purpose reactor is qualitatively (not merely quantitatively) different from a dual-purpose reactor, and one must choose, at the present stage of the art, to develop in one direction or the other.

Information made public by AEC on its proposed pricing policy is limited out of consideration for national security. We have, however, the following statement which throws some light on specific features:[48]

1. The planned expenditures for weapon materials will not be increased for the benefit of nuclear power.

2. AEC will acquire special nuclear materials from licensees for subsequent distribution to other licensees and for other potential uses. The price structure gives effect to a consideration of value of these materials for intended use by the United States.

3. Prices for fuel grades of plutonium and U-233 will be based on their value as nuclear fuels, competitive with U-235, in a power-reactor economy.

4. Prices paid by AEC are subject to adjustment for the full cost of separations, recovery, etc., if the materials are in a form other than indicated in the price schedules.

5. The prices stated in the schedules are subject to adjustment for deviations from the specifications on which they are based.

6. Prices to be paid by AEC for special nuclear materials produced by licensees will be guaranteed for a period of 7 years, except for periodic adjustments if there are substantial changes in the Bureau of Labor Statistics Wholesale Price Index, excluding farm products and processed foods.

Points 1 and 3 reflect the single-purpose approach, but, as if in contradiction to point 3, point 2 opens the way for dual-purpose pricing.[49] Point 6 provides a benchmark for planning private power plants. Until a private market has developed for special nuclear materials, there is no way to be sure what the single-purpose price will be. If such a price is envisaged in the seven-year guarantee, the AEC must

[45] See Weil, *Economic Feasibility: The Single Purpose Nuclear Power Plant*, *id.* at 50.

[46] See remarks prepared by W. Kenneth Davis, Director, Division of Reactor Development, AEC, for presentation before a meeting of Canadian Electrical Ass'n, Vancouver, B.C., AEC Release, June 29, 1955.

[47] For a view, expressed in another context, that the defense program may extend for a period of time on the order of only ten years, see the testimony of Jesse C. Johnson, Director of Raw Materials, AEC, in *Hearings, supra* note 13, pt. 1, at 131. One is also reminded of the view held by Gordon Dean, ex-Chairman of the Atomic Energy Commission, to the effect that at some point "*not* in the *unforeseeable* future," we shall have acquired all of the atomic weapons we shall possibly need, and at that time, we should cease to produce atomic weapons. See his remarks before the American Bar Association, San Francisco, Cal., AEC Release, Sept. 17, 1952.

[48] Prepared statement read into the record by Kenneth D. Nichols, in *Hearings, supra* note 13, at 74.

[49] For an explanation of the licensee status to which the pricing policy refers, see note 57 *infra*.

take into account a wide variety of economic and technological considerations in estimating it.[50] It is not known how the Commission proposes to use the BLS Wholesale Price Index.

Economically speaking, the single-purpose approach has much to recommend it. It forces the nuclear power industry to develop in a way that will make it self-supporting in the absence of military demands, which may not, and we hope will not, continue to be important over the long run. As a technique of public aid, the Commission's alternative of financing research and development has a number of positive features to recommend it, as we have seen. These, in combination with the negative qualities of the dual-purpose approach, strongly support a policy in which public aid takes the form of research and development assistance rather than the stockpiling of bomb components.

ATOMIC POWER STATIONS

The nation's first civil atomic power plant is scheduled to begin the production of electricity in 1957. This, of course, will be the pressurized water reactor at Shippingport, Pennsylvania, with a generating capacity of 60,000 kilowatts. The plant is financed in large part through AEC appropriations, as we have noted, in the five-year program. The Commission is spending $45 million in related research and development and is providing the nuclear reactor and related equipment to the extent of $40 million. The Duquesne Light Company, in a contract with the Commission, has agreed to provide the site for the nuclear reactor and furnish conventional generating facilities; to operate the reactor part of the plant and bear the labor costs thus entailed; to assume $5 million of the cost of research, development, and construction of the reactor portion of the plant; and to pay the Commission for heat in the form of steam taken from the Commission's reactor.[51] Over a five-year period, the Commission estimates that Duquesne's purchases of energy from the reactor will total $11.8 million.[52] The cost of conventional electric generating equipment being furnished by Duquesne is approximately $9 million.[53] The Commission has estimated that the total of all of Duquesne's expenditures over the five-year period that is being used for amortization of the plant[54] will be approximately $30 million.[55] In comparison with the $40 million provided by the AEC, this means that for the power plant, the private electric power company is paying less than half, or about 43 per cent, of the total estimated costs. This, however, is not an unfavorable arrangement for the Commission in view of the costs of electricity from atomic

[50] 68 STAT. 931, 42 U.S.C.A. §2076 (Supp. 1954) prescribes the seven-year maximum in this guarantee.

[51] The Duquesne contract is described in *Report, supra* note 12, Appendix B, at 24-25 (1954).

[52] Personal communication, Atomic Energy Commission, July 27, 1955.

[53] See *Hearings, supra* note 13, at 99.

[54] Defense mobilization Order VII-6, Amdt. 9, effective March 17, 1955, added a new expansion goal, No. 225, to its List III, entitling affected industries to accelerated tax amortization certificates. Goal No. 225 is for "Power facilities for military, atomic energy and defense related needs." See 20 FED. REG. 1647 (March 18, 1955).

[55] See *Report, supra* note 12, Appendix B.

energy, which, we have seen, the Commission places at two to three times the level of conventional power.

The next two atomic power stations likely to be constructed have been proposed by the Detroit Edison Company and associates and by the Nuclear Power Group, led by Commonwealth Edison Company of Chicago. The proposals for these two plants were made upon an invitation of January 10, 1955 by the Commission to American industry to submit proposals for full-scale atomic generating facilities.[56] Approved proposals would become part of the Commission's Power Demonstration Reactor Program. A deadline of April 1, 1955 was set for the submission of proposals. Under the arrangements envisaged for the demonstration program, as has been seen, the Commission offered to provide assistance by: (1) waiving interest charges (which the AEC has set at 4 per cent) for the loan of source and special nuclear materials for a seven-year period beginning July 1, 1955; (2) performing in AEC laboratories without charge to participating firms certain mutually agreed upon research and development work; and (3) entering into research and development contracts with participating firms.

The last type of assistance would place the participating firms in a dual role. For their self-financed private activities in the demonstration program, the participating firms would hold AEC licenses, either section 103 licenses for the commercial use of special nuclear materials or section 104 licenses for the private conduct of atomic research and development.[57] As the Commission conceives the process, participating

[56] See AEC Release No. 589, Jan. 10, 1955.

[57] 68 STAT. 936-38, 42 U.S.C.A. §§2133-34 (Supp. 1954).

The key provisions for commercial (§103) licenses are:

(1) Licenses shall be issued on a nonexclusive basis;

(2) They shall be issued to applicants

(a) whose proposed activities will serve a useful purpose proportionate to the quantities of special nuclear material or source material to be utilized,

(b) who are equipped to observe and who agree to observe such safety standards to protect health and to minimize danger to life or property as the Commission may by rule establish, and

(c) who agree to make available to the Commission such technical information and data concerning activities under such licenses as the Commission may determine necessary to promote the common defense and security and to protect the health and safety of the public;

(3) Licenses shall be issued for specified periods, not to exceed forty years and are renewable.

The key provisions for the research and development (§104) licenses are:

(1) The Commission is authorized to issue licenses for facilities involved in research and development leading to the demonstration of the practical value of such facilities for industrial or commercial purposes;

(2) In issuing licenses, the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under the Act to promote the common defense and security and to protect the health and safety of the public;

(3) Such licenses will be compatible with the regulations and terms of license which would apply in the event that a commercial license were later to be issued pursuant to section 103 for that type of facility (reference is to facilities mentioned in item (1) above); and

(4) Priority shall be given to facilities which the Commission feels will lead to major advances in the application of atomic energy for commercial or industrial purposes.

Regulations to implement these and related provisions of the 1954 legislation have been appearing since April 1955. The list of topics upon which the Commission has or will soon issue regulations follows:

(1) Licensing of special nuclear material distribution;

(2) Licensing of utilization and production facilities;

firms in the demonstration program will first operate under section 104 and then under section 103 licenses.[58] The difference is a matter of degree. For that part of a participating firm's work carried out under a research and development contract,[59] the information acquired would remain under the control of the Commission, subject to the same distributional program as obtains under traditional contracts generally employed by the AEC for research and development; the information in that other (privately financed) part of a firm's activities, however, could be privately controlled within the limits of patent rights, as these apply in the evolving civil reactor development field.[60] To the extent that there is private investment in the demonstration program, the Commission feels that the anticipation of know-how and patent rights will have provided the incentive.[61]

The AEC criteria for evaluation of proposals under the demonstration program include: (1) the probable contribution of the proposal toward economically competitive atomic power; (2) the cost to the AEC in funds and materials; (3) the risk to be assumed by private proposers; (4) the competence and responsibility of the proposers; and (5) assurances by proposers against abandonment.[62]

Four proposals were received under the January 10, 1955 invitation with its

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(3) Control of restricted data (as used by licensees, among others);
(4) Access to restricted data for civilian use;
(5) Licensing of operators—the individuals who manipulate the controls of a utilization or production facility;
(6) Licensing of distribution and use of byproduct material;
(7) Licensing of distribution and use of source material;
(8) Standards for radiation protection;
(9) Rules of practice (hearings);
(10) Prices to be paid by the Commission for special nuclear materials produced by licensees;
(11) Charges to be made by the Commission for certain materials, including special nuclear materials; and
(12) Criteria governing the use of commission facilities.

The overriding criteria in all of these regulations, it has been announced, is the necessity of the regulation for the protection of the public health and safety and for the national security. *Cf.* Remarks by Harold L. Price, Director, Division of Licensing, AEC, before the Atomic Industrial Forum, New York, AEC Release, May 24, 1955.

[58] See the testimony of Kenneth D. Nichols, in *Hearings, supra* note 13, at 155.

[59] The AEC has announced that the amounts to be paid under the contracts will be fixed in advance. See AEC Release No. 589, Jan. 10, 1955.

[60] There has been some question as to whether the legislative framers of the Atomic Energy Act of 1954 intended to permit assistance of the type here described for firms holding §§103 or 104 licenses. The statutory provision in issue is §169, which reads:

"No funds of the Commission shall be employed in the construction or operation of facilities licensed under section 103 or 104 except under contract or other arrangement entered into pursuant to section 31." 68 STAT. 952, 42 U.S.C.A. §2209 (Supp. 1954).

Since the Commission proposes to contract for research and development under §31 (which deals with research assistance), the authority of the AEC to do this seems clear. But a number of members of the Joint Committee on Atomic Energy, including especially Representative Cole, have protested on the grounds that the exception in §169 was intended only to permit the AEC to contract for public use of private reactors at the convenience of the Government. The Commission's interpretation has been supported by other members of the Joint Committee, however, including especially Representative Holifield, and indications are that it will prevail. For the controversy, see *Hearings, supra* note 13, at 155-62.

[61] See the testimony of Kenneth D. Nichols, in *Hearings, supra* note 13, at 171-72, 173.

[62] See AEC Release No. 589, Jan. 10, 1955.

April 1 deadline. Two of these, as we have noted, were made by groups of firms centering around the Detroit Edison Company and the Commonwealth Edison Company of Chicago. The other two were made by the Yankee Atomic Electric Company of Boston, with a membership constituted of twelve New England concerns, and by the Consumers Public Power District of Columbus, Nebraska.[63] All of these groups had been holders of study agreements with the Commission for a number of years. Under no other circumstances could they have seriously proposed to commit funds to atomic power installations within the time limit. The AEC recognized the advantages held by firms already associated with the atomic energy program and noted that the situation was inevitable in view of the objective of rapid progress.[64]

In announcing the four proposals, the Commission indicated that the four plants together would cost about $150 million, 80 to 90 per cent of which would come from the proposers.[65] The remaining $15 to $30 million would, if the AEC approved the projects, come in the form of assistance previously described for the demonstration program. Appropriations for this assistance, and apparently for assistance in later demonstration projects, were made, as we have noted, in the Acceleration of Civil Power item for fiscal year 1956 (*cf.* Table I).

Several months later, in August 1955, the Commission disclosed that it had found that the Detroit Edison and Commonwealth Edison groups' proposals would make significant technological contributions and, hence, that negotiations were proceeding with these two groups.[66] At the same time, the AEC revealed that the proposals by the Yankee Atomic Electric Company and Consumers Public Power District of Columbus, Nebraska, were judged to be unacceptable bases for negotiation as they then stood, although the door was left open for further discussion to determine whether they could be made acceptable.[67] The Commission, of course, did not indicate how much financial assistance it might eventually agree to provide for the two technologically acceptable projects.

A final atomic power station under consideration by the Commssion at the time of this writing (August 1955) was proposed by the Consolidated Edison Company of New York in the winter months of 1955. Consolidated Edison's proposal is not a part of the demonstration program, for it involves no AEC assistance other than the grant of a license. Consolidated Edison proposes to build a nuclear power plant which it estimates will cost approximately $55 million.[68]

The investment of private funds in atomic power stations is not explicable in terms of present reactor technologies. We have noted the present high cost of atomic power and the probable passage of time until it is expected to be competitive with

[63] See AEC Release No. 620, April 7, 1955.
[64] See the testimony of Chairman Strauss, in *Hearings*, *supra* note 13, at 25.
[65] See AEC Release No. 620, April 7, 1955.
[66] See AEC Release No. 674, Aug. 8, 1955.
[67] *Ibid.*
[68] See AEC Release No. 620, April 7, 1955.

conventional power. Nor does it appear that the prospect of acquiring private patent rights would be sufficient incentive in view of both the magnitude of the private investment here involved and the length of time before such patent rights would become profitable. The answer, instead, seems to lie especially with certain rate-making practices that have been or may be adopted by state public utility commissions. To the extent that such practices are adopted, we shall see that private atomic power installations in pre-competitive years will be financed at the consumer's expense.

The Detroit Edison Company and associates plan to build a 100 megawatt fast breeder reactor plant within Detroit Edison's service area in Michigan. Detroit Edison will buy from the plant steam heat at a cost to be determined by a formula based upon the operation of a conventional steam plant and using as a criterion the company's most efficient generating plant.[69] Thus, the nuclear power plant will lead to no higher electric power rates than would a modern conventional plant. This, however, is not the point at which the costs of the nuclear plant will be recovered. Detroit Edison has stated that it will furnish $5 million of an esimated $45 million for the construction of the plant.[70] The other $40 million is to be furnished by the other members of the group, numbering sixteen utilities and six manufacturing companies from ten different states and the District of Columbia.[71] Detroit Edison has obtained an accounting order from the Michigan Public Service Commission authorizing it to reflect the $5 million expenditure in the utility's Account 801, Miscellaneous General Expenses.[72] This means that in the normal course of events, the $5 million will be charged to the Company's power cost pool, along with the cost of other electrical generation or power purchases, and that the total amount in this pool will be spread over all consumers.[72a] In the hearing preceding the Commission's order the petitioner made clear that the $5 million, considered at a yearly rate of $1¼ million and with allowance for income taxes, would not affect net revenue sufficiently in itself to bring an application for rate increases, but would, nevertheless, remain an element of value in general support of future rate increases.[72b]

The Nuclear Power Group plans to build a 180 megawatt boiling-water-reactor plant about 44 miles southwest of Chicago, in a service area from which three of the member firms, Commonwealth Edison Co., Illinois Power Co., and Central Illinois Light Co. can draw electricity. Commonwealth Edison will own and operate the

[69] Letter from Michigan Public Service Commission to author, Aug. 11, 1955.

[70] *Ibid.*

[71] The membership of the Detroit Edison group has expanded since the group's initial formation. As given in AEC EIGHTEENTH SEMI-ANNUAL REP. 42 (July 1955), there were nineteen members in addition to the Detroit Edison Company. The list of members used here is from AEC Release No. 674, Aug. 8, 1955.

[72] See Mich. Pub. Serv. Comm'n, Accounting Order D-1282A-55.1, March 23, 1955.

[72a] Letter from the Michigan Public Service Commission to the author, Aug. 26, 1955.

[72b] See the testimony of Charles R. Landrigan, Vice-President, Detroit Edison Company, in *Hearings before the Michigan Public Service Commission in the Matter of the Application of the Detroit Edison Company for Directions as to the Accounting Treatment for Disbursements Made or Expenses Incurred in the Design, Construction, and Operation of a Developmental Atomic Power Reactor* 35, 39-42 (1955).

plant and will pay $30 million toward a $45 million contract price for which the General Electric Company has agreed to build the plant.[73] The $30 million will enter Commonwealth Edison's plant accounts as a normal plant investment subject to customary practices for full recovery of fixed costs and a return on the value of the property.[74] The remaining $15 million will be paid by Commonwealth Edison and other members of the Nuclear Power Group, including six other electric utilities and one construction firm, the Bechtel Corporation of San Francico, which will act as engineering constructor for General Electric.[74a] In so far as the $15 million involves the three Illinois utilities, they have received authority to charge their contributions over a five-year period as operating expenses to Account 801, Miscellaneous General Expenses, subject to the limitation that the amounts of such charges do not exceed $625,000, $330,000, and $110,000 for Commonwealth Edison, Illinois Power, and Central Illinois Light respectively, in any twelve-month period.[75]

The inference seems clear that the other electric utility members of the Nuclear Power Group, representing two other states, will seek, or have sought, similar orders from their state commissions and that the far-flung utility associates of the Detroit Edison Company will do likewise. By letter, dated August 8, 1955, the New York Public Service Commission advised the author that it had not taken any formal action with respect to the development, operation, or rate aspects of generation of electricity from nuclear installations. Involved in New York would be the Consolidated Edison Company, with its proposed independent nuclear power project, and members of both the Detroit Edison and the Nuclear Power Groups.

The process of financing pre-competitive nuclear power installations from expenses chargeable to electric rates in effect throws the risk of the research and development upon the consuming public, but without the same prospect of broad public benefit as attends research and development supported at federal expense. In the nature of things, electric utilities do not have and are not expected to have either the same organization for dissemination of information or the same techniques or responsibilities for representing the public interest as has the AEC. Present policy, perhaps developed in another context and, in any case, questionable for atomic power stations, however, explicitly permits the assignment of research and development expenditures to Account 801 in the uniform system of accounts which has been prescribed by the Federal Power Commission[76] and which has been adopted, in so far as this provision is concerned, by the Michigan, Illinois, and most other state regulatory commissions. And patent rights resulting from research and development so financed have, in the past, been acquired by the private electric utility.

The magnitude of the prospective investment in pre-competitive atomic power

[73] See Ill. Commerce Comm'n, Order No. 42638, July 19, 1955.

[74] *Ibid.*

[74a] For the membership of the Nuclear Power Group, see AEC Release No. 674, Aug. 8, 1955.

[75] See Ill. Commerce Comm'n, Order No. 42638, July 19, 1955.

[76] See Federal Power Commission, Order No. 42, Prescribing a System of Accounts for Public Utilities and Licensees under the Federal Power Act, June 16, 1936. 18 C.F.R. §101.00 (1949).

facilities strongly suggests a reconsideration of this practice. The Detroit Edison and Commonwealth Edison applications for approval of a practice ostensibly well established suggest that the construction of a full-scale electric power station for the purpose of generating electricity at a cost two or three times the cost of alternative methods in order to advance technology is something of an extension of the research concept. But dangers are involved. To the extent that patent rights under the Atomic Energy Act 1954 may accrue to electric utilities, these should be excluded from their intangible property accounts. Their inclusion would permit the capitalization of an asset already paid for through charges to operating expenses. On the other hand, even if so excluded, any such patent rights, acquired at public expense, might well have value either through sales to other utilities, which would necessarily be allowed to treat them as legitimate capital investments, or through sales on the open market.[76a] A related problem arises from the fact that the charges to Account 801 will be, at least in part, for physical plants. Such charges should not be capitalized any more than should patents arising from research paid for through the same operating expense account; but it will take careful administration to insure that the distinction will always be recognized when, for example, some parts of a plant, but not others, are charged to Account 801, or when the value of a utility's property for rate making purposes is determined by appraisal.

Another public policy problem is posed by the $30 million investment of Commonwealth Edison in its boiling water reactor plant. Traditionally, public regulatory bodies have hesitated to pass upon the merits of a technology embodied in a new investment. The matter is usually regarded as properly a concern of management alone, over which regulatory commissions do not want, and, in fact, generally lack the authority, to exercise control. This "hands off" approach has been supported by the popular assumption that new investments will follow least-cost techniques of production. Now we find that this assumption is fallacious to a marked degree in the atomic power plants in prospect. The justification for these plants, instead, is given in terms of the lessons that will be learned in operating them. This means that the real investment in technological progress is made, not by the utilities that own and operate the plants under traditional arrangements for recovery of their investments, but by the consuming public to the extent that it is asked to pay higher rates for electricity.

To be sure, the amounts involved in the nuclear plants now in prospect are small as compared with the total investment in the electric power industry, and the burden is spread more broadly by the practice of forming industrial groups. Moreover, there will undoubtedly be some private capital from nonreimbursable sources provided. The presence of non-utility members in the two power groups suggests this; and the possibility that the utilities themselves will invest out of retained

[76a] The Detroit Edison Company has taken the position that it is not seeking patents from its atomic energy research. See the statement prepared by Harvey A. Fischer, Attorney for the Detroit Edison Company, in *Hearings, supra* note 72b, at 7. It is not known whether other utilities have taken the same position.

earnings or another nonreimbursable source should not be excluded. Despite these facts, however, the precedent for financing through recoverable expenses may soon be firmly established, and if carried through the pre-competitive era of nuclear power, this will add a substantial increment to total power costs.

If it is necessary to build atomic power stations for the purpose of advancing reactor technology, an earlier proposal made by Dr. Hafstad in July 1954 has much to recommend it. Under this proposal, as we have seen, the AEC would share the costs of investment to the extent that atomic power costs exceeded conventional power costs, possibly as in the Duquesne Light project. The resulting technological knowledge would become public property, subject to the established AEC systems for dissemination of technological information.[77]

Expenditures upon atomic power stations that are reimbursed by consumers, plus any other payments by consumers for atomic power at a higher cost than conventional power, are probably best treated as public investments. The purpose, as we have seen, is to advance atomic power technology. Such investments by electric power consumers have a different incidence among members of the public than do AEC investments—this difference being especially dependent upon the location of atomic power plants and the membership of nuclear power groups—but with some simplification of concepts, they are equatable. This means that the two may be lumped together in estimating the grand total public investment in atomic power development. If public policy should return to Dr. Hafstad's suggestion of July 1954 for AEC support of the differential between atomic and conventional power costs, this would not change our total, though it would, of course, change the private property rights that could accrue to participating electric utilities. On the other hand, any private nonreimbursable capital investments in atomic power stations (not in other private research and development, which does not enter here) would have to be offset against the estimate we shall make. This means that our estimate will be a maximum that may be reduced by such private investments.

A rough approximation of the difference between the higher-cost atomic electricity and the cost of conventional power that would otherwise be produced from plants installed in the decade 1958-68 can be made as follows. Let us take certain figures given in October 1954 by Mr. Davis on the relationship between present-day nuclear reactor plants and future competitive nuclear plants. These figures show that the AEC hopes to attain competitive atomic power by reducing the construction cost of nuclear plants fourfold, increasing the length of their useful life one and a half times, and, by an interpretation of the figures, reducing over-all operating costs

[77] The National Association of Railroad and Utilities Commissioners formed a Committee on Development and Use of Atomic Power in the Electric Industry, which requested and received AEC approval in July 1953 to obtain full security clearance to study the atomic power development program. See AEC Release No. 489, July 13, 1953. The problems here described would seem of special concern to the NARUC, but the author has been unable to learn of any announcement of the Committee's views.

one and a half times.[78] If we assume that atomic power will become competitive with conventional power at the beginning of the year 1968, we can deduce from Mr. Davis' figures that for atomic power plants constructed in the ten-year span, 1958-68, the deficit due to the use of atomic power will decline from 66.7 per cent of the total cost of all atomic power generated from the one plant in operation at the beginning of 1958 to zero per cent for the first new plant to operate in 1968; and further, that the ratio of fixed cost to total cost per kilowatt-hour generated will decline from 66.7 per cent for the 1958 plant to 33.3 per cent for the first 1968 plant. Next, we can approximate changes in physical plant costs from the fact, stated to the author, that competitive nuclear power is expected when plant costs have been reduced to $165-$170 per installed kilowatt.[79] Let us assume that this level will be achieved in the first atomic plant to operate in 1968. Working back from this level, with the help of Mr. Davis' requirement for a fourfold reduction in plant construction costs, let us choose $670 per installed kilowatt as a representative figure for atomic

[78] See Remarks prepared by W. Kenneth Davis, *supra* note 26. The following table was set forth:

APPROXIMATE RATIO OF COSTS NOW ATTAINABLE TO COSTS REQUIRED FOR ECONOMICALLY COMPETITIVE NUCLEAR POWER

Nuclear steam plant	*Range*	*Rough Average*
Construction cost	2 to 6	4
Useful life	1 to 2	1½
Fuel elements		
Fabrication cost[1]	4 to 20	8
Irradiation life	3 to 10	5
Overall thermal efficiency	1¼ to 2	1½
Nuclear fuel cost[2]	about 1	about 1
Operation & maintenance cost	1½ to 2½	2
Operating factor	1 to 1½	1¼
Processing costs		
Chemical separations	1½ to 4	2
Waste disposal	1 to 3	2
Overall	2 to 5	3±

Notes:

[1] For high temperatures and long life.

[2] Assuming recycle of nuclear material as fuel.

Fixed costs are shown under the item "Nuclear steam plant." If the construction cost is reduced fourfold and the useful life extended one and a half times, this constitutes a sixfold reduction in the fixed cost per kilowatt-hour over the life of the plant.

Operating costs cannot so neatly be picked out of Mr. Davis' figures, since many facts he reports bear upon them. We can, however, determine the effective total reduction envisaged for operating costs. A reasonable approximation of the present cost structure for nuclear power plants places fixed costs per kilowatt-hour generated at twice the level of operating costs. This means that if X is present-day fixed cost and Y is present-day operating expense, we have the equation $X = 2Y$. Next, from Mr. Davis' estimates, we place $X + Y = 3$ with present-day technologies and $\frac{X}{6} + \frac{Y}{Z} = 1$ with future competitive atomic technologies, where Z is the factor by which operating costs are expected to be reduced in order to achieve competitive nuclear power. Solving these three simultaneous equations, we conclude that present day nuclear power costs are composed approximately of ⅔, or 66.7 per cent, fixed costs; that future competitive nuclear power costs are expected to be composed approximately of ⅓, or 33.3 per cent fixed costs; and that operating costs are expected to be reduced by a factor of 1½ in the process of achieving this competitive level.

[79] Personal communication, Atomic Energy Commission, July 27, 1955.

capacity coming into operation at the beginning of 1958.[80] For the sake of a rough approximation, let us now assume that these three changes—decline in deficit due to use of atomic power, change in ratio of fixed to total cost, and reduction in fixed cost per installed kilowatt—will take place in straight line relationships over the decade, and that the plant factors will remain the same in all atomic plants. Then, we can find the value for each of the three variables in each year, and, from the growth rates lying behind the estimates in Table II, we can get the nuclear capacity installed each year, which permits calculation of the deficit that will result over the life of the atomic facilities coming into operation during each year of the pre-competitive decade.[81] Summating these deficits gives a total public investment in atomic power stations of $1.4 billion for the FPC-Lane growth estimates and $1.8 billion for the Davis estimates.[82]

PUBLIC BENEFITS

The reasons for the public effort in civil atomic power development have been explained in a number of ways by different atomic energy spokesmen.[83] A consensus seems to place weight upon international as well as domestic economic benefits. The latter will be important for New England, Florida, the Dakotas, and other regions of high fuel cost in the years ahead, and more broadly significant in the late decades of the twentieth century when conventional fuels are expected to become more expensive. The former have been frequently associated with the present civil reactor effort

[80] The figure $670 per installed kilowatt is more or less confirmed by what we know of the Duquesne plant. We have seen that the AEC is furnishing $40 million for the nuclear reactor and related equipment. Duquesne Light Company's $5 million is largely for research and development, while its $9 million is for auxiliary conventional equipment. Taking only the $40 million for the nuclear reactor plant with its generating capacity of 60,000 kilowatts, we get a conservative estimate of $667 per installed kilowatt.

[81] The deficit to result from atomic plants constructed in a given year, i, may be computed by the formula:

$$\left(\begin{matrix}\text{Atomic}\\ \text{Deficit, \$}\end{matrix}\right)i = \frac{\left(\dfrac{\text{Deficit, \$}}{\text{Total cost of electricity, \$}}\right)i \left(\begin{matrix}\text{Physical facilities}\\ \text{installed, kw}\end{matrix}\right)i \left(\begin{matrix}\text{Cost of physical}\\ \text{facilities installed, \$/kw}\end{matrix}\right)i}{\left(\dfrac{\text{Cost of physical facilities installed, \$}}{\text{Total cost of electricity, \$}}\right)i}$$

[82] Most of the deficit for the Duquesne plant is excluded from these figures, since the largest part of it was covered by AEC expenditures (*cf.* Table I).

[83] The most significant public statements include the following: Rep. W. Sterling Cole, Chairman, Joint Committee on Atomic Energy, *Development of Atomic Power for Commercial Uses*, address delivered before the National Industrial Conference Board, New York, N. Y., Oct. 29, 1953; Rep. Chet Holifield, Member, Joint Committee on Atomic Energy, *The Hope of Electric Power from Atomic Energy*, remarks before the National Rural Electric Cooperative Ass'n, Jan. 13, 1954; Henry D. Smyth, Member, AEC, *Industrial Application of Atomic Energy*, address delivered at the Third Annual Conference of Business Economists, University of Chicago, Chicago, Ill., April 23, 1954; Lewis L. Strauss, Chairman, AEC, remarks before the Los Angeles World Affairs Council, April 19, 1954; Lawrence R. Hafstad, Director, Division of Reactor Development, AEC, *Industrial Atomic Power and Its Relation to Development of Other Natural Resources*, remarks before the Missouri Basin Inter-Agency Committee, Rapid City, S. D., July 21, 1954; Thomas E. Murray, Member, AEC, *Atomic Energy for Peace*, address at the International Convention of the United Steelworkers of America, Atlantic City, N. J., Sept. 21, 1954; W. Kenneth Davis, Director, Division of Reactor Development, AEC, *Nuclear Power Industry Development*, remarks at the Seventeenth Annual Meeting of the American Power Conference, Chicago, Ill., April 1, 1955.

in connection with the widely held conviction that the United States must lead in matters atomic, particularly where peaceful applications are involved. If low-cost atomic power reactors are developed first in this country, not only will it be a boon to national prestige, but it will also furnish an improved vehicle for concrete action in the aid of underdeveloped countries consistent with the President's Atoms-for-Peace proposal.

Domestic and international benefits are both responsible for the public investment in civil atomic power development, but it is beyond the scope of the present paper (and its author) to evaluate the international or to indicate more than some of the immediate domestic economic consequences. To this extent, however, an overall evaluation of the public investment in atomic power development is aided. An ample inventory of economic benefits, at least of the type that can be immediately foreseen, would allay any other public diseconomies, while a deficiency in the same area would make the more necessary favorable findings elsewhere.

We have estimated the AEC investment at $500 to $600 million through fiscal year 1958. There is the possibility that the AEC will continue to invest in civil reactor development in the decade 1958-68, but no public spokesmen have encouraged the idea. The closest approximation that we have been able to make for this decade is a maximum investment in atomic power stations by electric power consumers of $1.4 to $1.8 billion. If we add the AEC to the electric consumers' investment, we obtain a grand total of approximately $1.9 to $2.4 billion for the public investment in atomic power development. To the extent that private capital itself assumes the differential higher cost of atomic power stations, these figures should be reduced. Apart from the public investment, private research and development efforts will undoubtedly pick up momentum in the chemical, electrical equipment, and other service and supply industries.[84] All of these investments are chargeable, from the domestic economic standpoint, against savings in the cost of future electric power.

To illustrate the requirements of a write-off of the public investment, let us assume that starting upon January 1, 1968 new atomic power facilities will be built so as to generate electricity at a lower cost than new conventional steam power plants. Let us then postulate three possible levels for the cost saving: 2 mills, 1 mill, and ½ mill per kilowatt-hour of electricity produced at the generating station,[85] and postulate,

[84] Estimates of the future private investment in atomic power development have been made in a recent survey, ATOMIC INDUSTRIAL FORUM, A GROWTH SURVEY OF THE ATOMIC INDUSTRY 1955-1965 (1955). The Forum reports that industry and private organizations plan to spend $300 million for research and development activities in the four years, 1954-1958. The estimates are not in a form from which we can determine the planned expenditures of electric utilities, but we know that the four demonstration-program proposals and the Consolidated Edison proposal under consideration at the time of the Atomic Industrial Forum survey totaled an investment of $175 to $190 million in non-AEC funds. See AEC Release No. 620, April 7, 1955.

[85] The average cost of power generated in plants accounting for approximately 80% of the national capacity of steam plant generation in 1953 was 8.06 mills per kilowatt-hour. The 80% includes electric capacity of both public and private steam plants but excludes plants judged obsolete by the FPC. For a group of the 25 largest steam generating plants in the United States, the comparable figure is 7.77

further, that savings from the use of atomic power will continue at each of these respective levels over the years until the atomic power development investment has been completely retired in each case. For estimates of the atomic power capacity in existence in future years, we shall use the figures shown in Table II. Let us assume that both the Davis and FPC-Lane rates of growth will lead to competitive nuclear power at the beginning of 1968. Within the accuracy of these capacity estimates, we cannot distinguish between probable rates of technological advance. Moreover, technological progress will be more dependent upon the variety of nuclear power installations than upon their number.

Our public investments in atomic power development accumulate interest at a compounded rate. Let us choose a rate of two and a half per cent as being roughly representative of the cost of the federal debt over the time span here involved and, hence, as roughly representing the value to the public of money used in atomic power development. Interest is compounded to reflect the fact that the public receives no interest payments as such, annual or otherwise, but must leave interest and principal, as it were, for retirement from eventual savings in the cost of atomic power. To simplify the calculation, let us assume that for the AEC investment through fiscal year 1958, the principal will be committed in such a way that, in effect, all costs can be considered to have been made upon the single weighted average date of January 1, 1957. For the grand total public investment, a date closer to 1968 is in order, to take account, among other things, of a five-year period over which it is likely that consumers will pay for investments in atomic power stations, the arrangement proposed in the Detroit Edison and Nuclear Power Group projects. All things considered, let us select January 1, 1965 as representing the effective date for the grand total public investment.

Following our previously stated assumption, retirement begins on January 1, 1968 and, with the cost savings we have postulated and the capacity estimates set forth in Table II, proceeds at a rapid enough rate to offset accumulation of interest. Table III shows the dates upon which the cost savings from atomic power would complete the retirement. Years of retirement are not shown for the $1.9 billion public investment with the Davis estimates, since this investment was derived using the FPC-Lane estimates. The same reason, of course, explains the absence of years-of-retirement estimates for the $2.4 billion principal with the FPC-Lane growth sched-

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mills; and for a group of the 16 largest hydro-electric generating plants, 3.04 mills. The first average was calculated from FPC, STEAM-ELECTRIC PLANT CONSTRUCTION COST AND ANNUAL PRODUCTION EXPENSES (1954). The calculations assumed a 60% plant factor and, as proposed in an unpublished study by the FPC dated February 1953, assumed an annual fixed charge equal to 11.7% of investment in physical plant. This fixed charge takes account of interest, depreciation, insurance, and taxes, including income taxes. The averages for the 25 largest steam and 16 largest hydro-electric plants were calculated from data reported in FPC THIRTY-FOURTH ANN. REP. 66-67 (1954). These calculations were based upon actually experienced plant factors of 57.5% in the 25 steam plants and 60% in the 25 largest hydro-electric plants, which included the 16 hydro-electric plants for which an average cost was determined. For the 25 largest steam plants, the annual rate of 11.7% was used for fixed charges, but for the 16 largest hydro-electric plants, an annual fixed charge rate of 10.7% was adopted, following unpublished data from the FPC.

TABLE III

RETIREMENT OF INVESTMENT IN ATOMIC POWER DEVELOPMENT

Savings per Kilowatt-Hour	Year of Retirement			
	AEC Investment		Total Public Investment	
	Principal $500 million	Principal $600 million	Principal $1.9 billion	Principal $2.4 billion
Davis Capacity Estimates				
2.0 mills	1973	1973	–	1977
1.0 mill	1975	1975	–	1979
0.5 mill	1976	1977	–	After 1980
FPC-Lane Capacity Estimates				
2.0 mills	1977	1977	1984	–
1.0 mill	1981	1982	1990	–
0.5 mill	1986	1987	1999	–

ule. For the total public investment, using the Davis estimates, with a rate of saving of 0.5 mill per kilowatt-hour, retirement would not take place until a few years after the last year included in these estimates.

From Table III, we can get some idea of the magnitude of the stakes involved, but our final judgment of what the figures portend for the public interest must be cast in the context of a number of qualifications. First among these is the possibility that a general increase in the use of atomic fuels will restrain an upward movement in the price of conventional fuels. This qualification could have the effect of shortening the time required for retirement of the public investment. Other matters, some of which we have noted in previous discussion, will make more difficult the establishment of low electric power rates on the basis of a given level of cost savings.[86]

Beyond the nuclear capacity estimates upon which Table III is based, any retardation in the real cost of conventional fuels as a result of the adoption of atomic fuels should be credited against the cost of research and development of the latter. There are logical bases for thinking that such a retardation will take place, but the extent of its effect upon conventional fuel prices is difficult to evaluate. The adoption of atomic fuels by electric utilities will reduce the demand for conventional fuels and, to this extent, delay any increases in their prices. The President's Materials Policy Commission found that in 1950, electric power generation accounted for 23 per cent of the total national consumption of coal, 9 per cent of the gas, and 4 per cent of the oil,[87] while it predicted that in 1975, electric power generation would account

[86] For the professional economist, still other topics are of interest, though they do not change this analysis. See, *e.g.*, Kuznets, *Notes on the Quantitative Approach to Economic Growth*, in PROBLEMS IN THE STUDY OF ECONOMIC GROWTH 117 (National Bureau of Economic Research 1949); and Merlin, *The Theory of Economic Change*, 59 Q. J. ECON. 185 (1945).

[87] See 3 PRESIDENT'S MATERIALS POLICY COMMISSION, *op. cit. supra* note 23, at 3, 16, 24, 33.

for approximately 44 per cent of the nation's coal consumption;[88] but it hesitated to predict total national gas or oil consumption from which the proportion pre-empted by electric power generation could be determined.[89] The President's Commission anticipated no generation of electricity from atomic fuels in 1975. It is clear that, at least in the market for coal, the extent of adoption of nuclear fuels shown by either the Davis or FPC-Lane estimates in Table II will significantly reduce total national demand below what it would be without atomic power. The price effects of this are not immediately obvious. We assume that coal technology will progress independently of atomic power development. The coming of nuclear power will take place over a period of decades, and, hence, in so far as its influence is concerned, conventional fuel output will have time to make long-run changes. Capital and manpower will have time to adjust. Since coal is a depletion industry, it is reasonable to expect that long-run cost changes would be upwards, but, beyond the immediate problems associated with a growing scarcity of beds minable by drift or slope entries and of deposits minable by strip methods, the President's Commission took the position that depletion of our national coal resources has not reached the point where long-run costs need to change significantly as a result of moderate expansions or contractions alone.[90]

The Table III figures would be influenced in the opposite direction by the appearance of private property rights in consumer-financed inventions. These would, as we have noted, prevent a full reflection of corresponding cost savings in consumers' electric power rates. Private property rights from risk-capital investments would have the same effect, but would be offset by the private research and development for which there had been no previous compensation and which might otherwise have been conducted at public expense. Such private investments will be made with the expectation of coverage by future cost savings in atomic power. Their presence will add to the total social investment in atomic power and, hence, to the total benefits necessarily expected from it.

From another standpoint, it is worthwhile to speculate as to whether the atomic investment need be as large as we have estimated it in order to get the same technological results. We have noted that the rate of progress in atomic power stations will depend more upon their variety than their number. The AEC applies this idea in approving projects for its demonstration program. Accordingly, it is not certain that we need have the volume of pre-competitive nuclear

[88] See I *id.* at 116, 119.

[89] In the decades after 1970, when there is some prospect that coal may be used to make liquid fuels, the percentage used in electric power generation should again decline, whether or not we make an allowance for the use of atomic fuels. And if solar energy becomes as widely useful as some authorities suggest, the amount of electricity generated by both atomic energy and conventional fuels may fall below the expectations we have considered. See an address by Dr. James B. Conant, President of Harvard University and Honorary President of the Twelfth International Congress of Pure and Applied Chemistry, at the Ceremonial Session of the American Chemical Society Diamond Jubilee Meeting, New York, N. Y., Sept. 5, 1951.

[90] See 3 PRESIDENT'S MATERIALS POLICY COMMISSION, *op. cit. supra* note 23, at 24-26.

power plants envisaged by either the Davis or FPC-Lane estimates. With respect to the AEC investment, the Commission is working along lines that it feels are most promising and, in so doing, seems to be seeking the best technological advice. The possibility exists, however, that a more leisurely approach, exploring one technological finding after another, might yield the same end results at a lower total cost. We know that the AEC is developing five different atomic power reactors. In addition, it is seriously considering expanding its efforts in two other directions.[91] Indeed, Chairman Strauss has likened the present civil reactor development effort to the wartime Manhattan Engineering District "crash" program for the production of an atomic bomb.[92] Mr. Strauss, of course, is not alone in his expressions of urgency. The importance of speed was reflected at the beginning of the current civil power effort in the Joint Committee's foreword to the initial public report on the five-year program. Referring to a meeting with the AEC, the foreword states:[93]

> . . . the Commission assured the committee that, whenever possible, the entire 5-year program will be speeded up as a result of any new scientific or engineering advances.

The costs of speed appear in the aggregate values we have assigned to the public investment in atomic power development, but they also may appear as roadblocks to public benefit from that investment. We have adequately explored the problem presented by atomic development for public utility regulatory commissions. Another aspect of the matter appears in the industries expected to serve and supply atomic power stations. Prominent firms in the chemical and electrical equipment industries are AEC contractors of long standing for the operation of production reactors and the conduct of reactor-development work. Others in boiler manufacture, shipbuilding, metallurgy, and aircraft manufacture have long played a part in reactor-development activities. It is widely recognized that these firms have gained a considerable edge over their noncontract-holding rivals in experience or know-how, particularly since the national interest long required secrecy in certain phases of reactor development. The problem is now to bring other members of these industries into sufficient contact with reactor technologies so that they can compete effectively. Unless public policy adequately prepares for it, workable competition will not be established at this level and we cannot expect the prices for supplies and services available to electric utilities to reflect the full cost savings made possible by the public investment in nuclear power development.

The Commission has taken a number of steps to bring outsiders into contact with atomic technologies. These have mostly to do with the AEC study and access programs, which we cannot examine at this point except to note a few of their results. Prime contractors of the Commission in fiscal years 1955 and 1952[94] included from

[91] See *Current Statement*, *supra* note 12, at 10-11.

[92] See *Hearings*, *supra* note 13, at 149.

[93] See *Report*, *supra* note 12, at iii.

[94] Data for fiscal year 1955 are from *Hearings before the Subcommittee of the House Committee on Appropriations on Independent Offices Appropriations for 1955*, 83d Cong., 2d Sess., pt. 3, at 2567 (1954); data for fiscal year 1952 are from *Hearings before the Subcommittee of the House Committee on Appropriations on Independent Offices Appropriations for 1953*, 82d Cong., 2d Sess. 1170-75 (1952).

the chemical industry an unduplicated total of five firms in reactor operation or reactor development, four of which were among the nation's eight largest chemical firms; and from the electrical equipment industry, an unduplicated total of six firms, five of which were among the nation's eight largest in this industry.[95] An adequate list of subcontractors in reactor development would moderate in some degree the impression given by these figures. But the important contrast is with study groups and access agreements, which, in combination, have brought in three more of the eight largest and ten to fifteen more of the smaller firms in the chemical industry. In the electrical equipment industry, no more of the eight largest appear among study-group members and access-permit holders, but five to ten other smaller electrical equipment firms are included.[96] Access permits were first issued in April 1955, and by far the greatest number of firms represented in the above figures received their first contact with atomic technologies under these permits between April and the end of July 1955, the terminal point for the information available at the time of this writing. Undoubtedly, access permits will continue to swell in number, but this is a late date for firms which have not previously been in reactor development to catch up with the years of experience gained by their larger rivals. Moreover, the latter have gained their experience or know-how while (for good reasons[97]) being reimbursed by the AEC and usually earning a profit as well.

The public interest in our national investment in atomic power development, as well as the continuing public interest in a competitive industrial society, requires redoubled efforts to bring broader participation in reactor technologies, at the expense of less rapid progress if necessary. We have suggested that a "crash" program in atomic power development might lead to higher expenses for the same technological knowledge than would a program conducted more deliberately. We now see that there is more at stake. If newcomers in the field do not have the chance to catch up competitively, through access agreements—or better, through participation—the technological fruits of progress will not be matched by commensurate advance in the general economic welfare.

[95] Size classifications follow FTC, REPORT ON THE CONCENTRATION OF PRODUCTIVE FACILITIES, 1947 (1949).

[96] Members of study groups have been reported in the Commission's semiannual reports. Access-permit holders through July 1955 have been reported in AEC Releases Nos. 647, 661, and 681, of June 10, July 12, and Aug. 16, 1955. The figures here reported are somewhat indefinite because of the difficulty in classifying some of the firms.

[97] *Cf.* note 34 *supra*.

INFORMATION CONTROL AND ATOMIC POWER DEVELOPMENT*

HAROLD P. GREEN†

The opening of the atomic energy industry to development and exploitation by private enterprise under the Atomic Energy Act of 1954[1] presents many unique and fascinating problems. Of these, the problems of information control are probably the most interesting and challenging because they represent an experiment without parallel in American law or industry.

The magnitude of the information control problem is implicit in the factual statement of its role in the statutory scheme: private development and exploitation of atomic energy is dependent, to a large extent, upon access to a classified technology controlled by the Atomic Energy Commission in the interest of the common defense and security. Through its control over access to information, the Commission can control entry of firms into the industry, relative competitive positions of competing firms, and proprietary interests in ideas. Even the very study and analysis of a "situation" by a firm to decide whether its resources should be committed to certain uses may require the Commission's approval. The impact of such a framework of government control upon a force such as atomic energy, which is destined to become a basic and pervasive force in the American economy, is obvious. If the present statutory scheme is continued, the growth of atomic energy out of infancy to full maturity is likely to have a profound effect upon many of our basic economic institutions and upon the long-term economic and political structure of American society.

I

THE STRUCTURE OF CONTROL

The statutory framework for atomic energy information control is based upon

* This paper was prepared while the structure of atomic energy information control for private development of civilian applications of atomic energy was in the process of formulation. It is based upon the legacy of eight years' experience under the original Atomic Energy Act, upon the AEC's proposed regulations under the 1954 act, and upon pertinent public statements of knowledgeable AEC officials. Some statements, based upon existing fact when written, may be inaccurate by the time of publication by reason of supervening events; similarly, analysis of the implications of information control may lose validity or take on new proportions. The paper demonstrates, nevertheless, the important and troubling implications stemming from such vast and unique delegation of authority and responsibility to control the flow and use of information. The implications and dilemmas discussed herein will be with us in one form or another so long as our Government continues to impose security-based information control upon democratic society and a free economy.

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[1] 68 STAT. 921, 42 U.S.C.A. §2011-281 (Supp. 1954).

the concept of "Restricted Data," which is defined in the Atomic Enery Act of 1954 to mean:[2]

> . . . all data concerning (1) design, manufacture, or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy, but shall not include data declassified or removed from the Restricted Data category pursuant to [section 142].

As a practical matter, this includes virtually all atomic energy information which the AEC believes warrants protection in the interest of security. It should be noted that the statutory definition embraces all information which falls within its terms, and no action by the AEC is necessary to make such data Restricted Data. The AEC may, thus, control the content of the Restricted Data category only[3] through its authority under section 142 to remove particular data from the category by declassification or transclassification.[4] Particular data may be declassified upon a determination by the AEC that it "can be published without undue risk to the common defense and security. . . ."[5] Thereafter, such data is free of all information control restrictions.

Restricted Data is subject to an array of statutory control provisions. First of all, the AEC is expressly authorized to control the dissemination of Restricted Data in such a manner as to assure the common defense and security.[6] At the same time, the act indirectly imposes upon the AEC the responsibility to exercise its control not only to protect Restricted Data, but also to disseminate Restricted Data, subject to appropriate safeguards, so as to encourage scientific and industrial progress.[7]

The heart of the information control system is the statutory requirement for security clearance of individuals who will have access to Restricted Data. The act contemplates that Restricted Data will be made available only to an individual who has undergone security investigation by the Federal Bureau of Investigation or the Civil Service Commission and who has been granted security clearance upon the AEC's determination that his access to Restricted Data will not endanger the

[2] §11(r), 68 STAT. 922, 42 U.S.C.A. §2014(r) (Supp. 1954).

[3] As a practical matter, however, the AEC must decide what information falls within the statutory definition, and, therefore, in a sense, the AEC determines what information is within the Restricted Data category. The AEC may control whatever information it says is Restricted Data until and unless its designation is successfully challenged in the courts.

[4] Declassification constitutes a complete removal of the data from the ambit of security protection. Transclassification, a new concept included in §142(d) and (e) of the Atomic Energy Act of 1954, 68 STAT. 941, 42 U.S.C.A. §2162(d), (e) (Supp. 1954), constitutes removal of data from the Restricted Data category so as to eliminate the special restrictions applicable to Restricted Data; but transclassified data receives continued protection thereafter as ordinary classified information. Transclassification is probably of no significance from the standpoint of civilian applications of atomic energy. It applies only with respect to data relating primarily to the military utilization of atomic weapons and to intelligence data concerning foreign atomic energy programs.

[5] §142(a), 68 STAT. 941, 42 U.S.C.A. §2162(a) (Supp. 1954).

[6] §141, 68 STAT. 940, 42 U.S.C.A. §2161 (Supp. 1954).

[7] Section 3(b) of the act states as one of the act's purposes provision for "a program . . . for the control, dissemination, and declassification of Restricted Data, subject to appropriate safeguards, so as to encourage scientific and industrial progress." 68 STAT. 922, 42 U.S.C.A. §2013(b) (Supp. 1954).

common defense and security.[8] The AEC is authorized to establish standards and specifications as to the scope and extent of the security investigations which will be required, based upon the sensitivity of the Restricted Data to which access will be permitted.[9]

Section 161(i) of the act[10] authorizes the Commission to prescribe regulations and orders deemed necessary to protect Restricted Data received by any person in connection with activities authorized under the act. In addition, the Commission may exercise information control through the provisions of its contracts and licenses.

The information control system is supported by an array of enforcement provisions. These provisions fall within five distinct categories.

1. Sections 224, 225, and 226 of the act provide severe criminal penalties for espionage-type offenses involving Restricted Data.[11] These penalties do not apply to situations in which there has merely been a violation of information control rules or an unauthorized disclosure of Restricted Data, but only to situations in which there has actually been some kind of espionage-like conduct—*i.e.*, where the act was committed with intent to injure the United States or to aid another nation, or with reason to believe such injury or assistance would result. These provisions are not of particular importance from the standpoint of the impact of atomic energy information control upon industry, since we may assume that very few, if any, individuals in the atomic energy industry would engage in conduct within the ambit of these sections.

2. Of somewhat greater importance is section 227.[12] This section was obviously designed to provide a realistic basis for penal action against persons who disclose Restricted Data outside the circle of authorized persons without any espionage-type intent or state of mind, an offense less serious in scope, iniquity, and consequence than the conduct proscribed under sections 224, 225, and 226.

Section 227 applies to any person who is or has been a government employee, an Atomic Energy Commissioner, a member of the Armed Forces, an employee of a government contractor, an AEC licensee, or an employee of an AEC licensee. Any such person who "knowingly communicates Restricted Data, knowing or having

[8] §145(a), (b), 68 STAT. 942, 42 U.S.C.A. §2165(a), (b) (Supp. 1954).

[9] §145(f), 68 STAT. 943, 42 U.S.C.A. §2165(f) (Supp. 1954).

[10] 68 STAT. 949, 42 U.S.C.A. §2201(i) (Supp. 1954).

[11] 68 STAT. 958, 959, 42 U.S.C.A. §§2274, 2275, 2276 (Supp. 1954). Analogous statutory provisions of the Internal Security Act of 1950, 64 STAT. 1003, 18 U.S.C. §§793 (Supp. 1952), are also probably applicable to espionage-type offenses involving Restricted Data, although the matter is not free of doubt. See Rosenberg v. United States, 346 U.S. 273 (1953). *But see* Newman, *Control of Information Relating to Atomic Energy*, 56 YALE L.J. 769, 790 (1947); Remarks of Senator Hubert H. Humphrey, 101 CONG. REC. 7883 (daily ed. June 27, 1955).

[12] 68 STAT. 959, 42 U.S.C.A. §2277 (Supp. 1954). An analogous provision is found in the Internal Security Act of 1950, 64 STAT. 1004, 18 U.S.C. §793(d), (e) (Supp. 1952), making it an offense punishable by a fine of up to $10,000 and/or imprisonment of as much as 10 years for any person willfully to communicate data relating to the national defense to unauthorized persons. If the data communicated is "information" rather than in tangible or documentary form, an element of the offense is "reason to believe" the information "could be used" to the injury of the United States or to the advantage of another nation.

reason to believe it is Restricted Data, to any person "not authorized to receive Restricted Data pursuant to the provisions of this Act or under rule or regulation of the Commission," knowing or having reason to believe the recipient is "not so authorized to receive Restricted Data," is liable for a maximum penalty of a fine of $2,500.

The efficacy of section 227 is open to serious question. An individual may be "authorized to receive *Restricted Data,*" but yet not authorized to receive *specific types of Restricted Data.* For example, a recipient may have an "L" clearance, entitling him to access to *Confidential* Restricted Data, but not to *Secret* or *Top Secret* Restricted Data. If an individual subject to section 227 communicated Secret or Top Secret Restricted Data to such a recipient, he probably could not be successfully prosecuted under section 227 even if he admitted knowledge that the recipient was not authorized to receive the data communicated, since it could not be successfully maintained that the recipient was not "authorized to receive *Restricted Data.*"[13] Since the statute and regulations require only security clearance for authorization to receive *Restricted Data,* successful prosecution would require proof by the Government that the communicator knew or had reason to believe that the recipient was not cleared. It would appear to be an almost impossible task for the prosecution to prove this against any kind of plausible defense. The weaknesses in section 227 could, of course, be easily overcome by a simple amendment changing this element of the crime to knowledge or reason to believe the recipient was not authorized to receive, under the Atomic Energy Act of 1954 or AEC regulations, *the Restricted Data communicated.*

3. Section 223[14] makes it a criminal offense for any person willfully to violate, attempt to violate, or conspire to violate any regulations issued by the AEC pursuant to section 161(i) of the act to protect Restricted Data. Conviction carries a maximum penalty[15] of a fine of $5,000 and/or imprisonment for two years. This provision is the most formidable in the entire enforcement array, and, in effect, gives the AEC's information control system the force and effect of a criminal statute. There is considerable question as to the wisdom of the Congress in delegating to the AEC such broad quasi-legislative authority in so novel a field with so few objective or specifically defined standards.

4. Another potent enforcement tool is provided by section 230,[16] which authorizes the issuance of injunctions to restrain violations of or compel compliance with the act and AEC regulations.[17]

[13] It should be noted that under these facts, prosecution could probably be successfully maintained under 18 U.S.C. §793(d) or (e) (Supp. 1952), *supra* note 12.

[14] 68 STAT. 958, 42 U.S.C.A. §2273 (Supp. 1954).

[15] If, however, the offense is committed with intent to injure the United States or to secure an advantage to any foreign nation, the penalty may be a maximum of a $20,000 fine and/or 20 years' imprisonment. *Ibid.*

[16] 68 STAT. 959, 42 U.S.C.A. §2280 (Supp. 1954).

[17] The AEC almost had the opportunity in 1950 to test the efficacy of its identical injunction authority under the original Atomic Energy Act of 1946. The publication *Scientific American* had gone to press

5. A final enforcement device is the AEC's authority to cancel contracts or revoke licenses for violation of AEC regulations.[18]

These provisions, taken together, vest the AEC with almost unlimited statutory authority to control dissemination of Restricted Data. The AEC's proposed regulations, issued pursuant to section 161(i), for safeguarding Restricted Data are expressly applicable to "all persons within or under the jurisdiction of the United States."[19] They provide that "no person possessing Restricted Data shall permit any individual to have access to . . . Restricted Data unless such individual has . . . clearance."[20] Any person, regardless of the nature of his past or present association, or lack thereof, with the atomic energy program, who discloses Restricted Data to unauthorized persons would probably be in violation of these regulations, and if his action is "willful," he may sustain heavy criminal penalties under section 223. In addition, if the AEC had advance notice of the proposed publication, it has authority to seek an injunction to restrain the violation. Application of these restrictions to information media, as is entirely possible under the 1954 act, would directly raise a serious question of censorship. It is a striking commentary on our times that legislation authorizing such curtailments of the flow of information has been accepted by the public without resistance.[21]

It has always been axiomatic that security of information varies inversely with the number of individuals who have access to the information. Accordingly, security programs have traditionally been based upon stringent limitations upon access to classified information. The cardinal principle has been that classified information may be imparted only to those individuals who, of absolute necessity, must

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with its April 1950 issue including an article on the hydrogen bomb written by Dr. Hans Bethe, an AEC consultant. The editors of *Scientific American* did not submit the article to the AEC for security review "since all the technical information in it was well known to physicists the world over and had been widely published." The AEC requested that certain portions of the article be deleted and was prepared to use its injunctive authority to support its request. With considerable reluctance, *Scientific American* complied with the AEC's request. The AEC then requested that all copies of the original article be destroyed, and an AEC security officer supervised the destruction of the type and printed plates and the burning of 3,000 copies of the magazine which had already been printed. See *Scientific American*, May 1950, p. 26.

[18] Section 186(a) of the Atomic Energy Act of 1954 authorizes revocation of atomic energy licenses for violation of or failure to observe any of the terms and provisions of the act or of any AEC regulations. 68 STAT. 955, 42 U.S.C.A. §2236(a) (Supp. 1954).

[19] Proposed AEC Regulations for the Safeguarding of Restricted Data §95.2, 20 FED. REG. 2495-96 (1955).

[20] *Id.* §95.31.

[21] The Atomic Energy Act of 1946 did not expressly authorize the AEC to issue information control regulations, and, accordingly, AEC regulations for protecting Restricted Data under the 1946 act lacked injunctive or penal teeth. During consideration of the 1954 act, there was considerable opposition to §227, but no opposition whatever to §161(i), which authorized information control regulations backed by injunctive authority and criminal sanctions, and which was a broader and more effective means, carrying heavier penalties, of accomplishing almost precisely the same object as §227. The principal difference is that prosecution for violation of §161(i) requires a showing of a "willful" violation, while under §227, the offense must be committed "knowingly," with knowledge or reason to believe that Restricted Data is involved and that the recipient was not authorized to receive Restricted Data.

have access in order to perform a function in a government program.[22] The fact that an individual has appropriate security clearance has not entitled him to access to particular classified information unless he also had such a "need to know."[23] Security clearance was, therefore, granted not to permit general access, but only to permit access to a specified area of information. The AEC security regulations prior to enactment of the 1954 act were based upon strict application of these principles.

It is apparent that under such a philosophy of security, there could be no place for development and exploitation by private enterprise of a classified technology. Private enterprise and personnel of private firms could have access to classified information only to the extent that such access was necessary in order to contribute to a government program in which they were involved. Private exploitation and development necessarily had to await declassification of the pertinent information.

Recent developments under the Atomic Energy Act of 1954, however, have marked a sharp break with the traditional concept of security. Instead of furthering the preservation of security based upon stringently limited access, the act exhorts the Commission to provide for broad dissemination of Restricted Data.[24] The shibboleth of security through limitation of access has been replaced by cautious introduction of the concept that security can be maintained even if large numbers of people have access, if they all are investigated and cleared and subject to realistic criminal sanctions if they violate the security rules. Similarly, the manner in which the AEC is administering the act results in a considerable attenuation of the "need-to-know" doctrine. Restricted Data now is to be made available to private persons even if they do not have a "need to know" in connection with accomplishment of a government program.

The problems of administering the unique information control provisions of the act, of adjusting the necessary departures from traditional security practices to the maintenance of an effective security program, and of administering an information control system in an equitable manner which will preserve free competition and avoid monopoly all present the AEC with a very substantial challenge. The manner in which the Commission proposes to meet this challenge is not yet wholly apparent, since it has not yet issued all pertinent regulations in final form. It is possible, however, on the basis of facts already available, to assess the AEC's general approach to the problem.

[22] Section 7 of Executive Order 10501, 18 FED. REG. 7049, 7053 (1953), provides that: "Knowledge or possession of classified defense information shall be permitted only to persons whose official duties require such access in the interest of promoting national defense. . . ."

[23] For example, §195.11(b) of the State Department's Security Regulations provides: "No person is entitled to receive classified . . . information solely by virtue of his official position or by virtue of having been granted security clearance. The 'need to know' doctrine shall be enforced at all times. . . ." See *Hearings before a Subcommittee on Reorganization of the Senate Committee on Government Operations on S. J. Res. 21, to Establish a Commission on Government Security*, 84th Cong., 1st Sess. 1183, 1237 (1955).

[24] See note 7 *supra*.

The AEC has adopted regulations dividing Restricted Data into the three categories of relative sensitivity used throughout the Government for security classification of information: Top Secret, Secret, and Confidential. Although the procedures prescribed for the handling of Restricted Data vary with respect to the three categories in accordance with their relative sensitivity, the categories have no significance from the standpoint of the Atomic Energy Act of 1954, since all the information control provisions of the act apply to Restricted Data as such, regardless of the particular classification involved.

Every person who is to have access to Restricted Data must have security clearance.[25] The Commission has, in accordance with section 145(f) of the act,[26] established requirements for two degrees of clearance based upon the category of Restricted Data to which access will be afforded. The "L" clearance will, in so far as concerns private industrial development of atomic energy applications, suffice for access to Confidential Restricted Data and is based upon a National Agency Check.[27] Access to Secret and Top Secret Restricted Data requires a "Q" clearance, based upon a full background investigation by the Civil Service Commission or the Federal Bureau of Investigation.[28] The only difference between an "L" clearance and a "Q" clearance, aside from the difference in access afforded, is in the scope of the required investigation. Although the standards for determining eligibility for clearance may theoretically be applied less stringently for an "L" clearance, where only relatively nonsensitive access is afforded, it is unlikely, as a practical matter, that such a distinction will be drawn.[29]

Under AEC security clearance procedures, an "L" clearance or a "Q" clearance would be revoked or denied only after the individual has been given a statement of the derogatory information and an opportunity for a formal hearing before a personnel security board, with the final clearance determination to be made by the General Manager. These procedures[30] follow the typical pattern of government security adjudications, although in some respects they are more enlightened. Suffice it to say, the procedures fall far short of accepted standards of due process.

It has frequently been said that the Commission's establishment of the "L" clear-

[25] §145(a), (b), 68 STAT. 942, 42 U.S.C.A. §2165(a), (b) (Supp. 1954).

[26] 68 STAT. 943, 42 U.S.C.A. §2165(f) (Supp. 1954).

[27] Proposed AEC Regulations for the Safeguarding of Restricted Data §95.3(d), 20 FED. REG. 2495-96 (1955). A National Agency Check consists of an examination of the records of the FBI, the Civil Service Commission, the House Committee on Un-American Activities, and other government agencies.

[28] *Id.* §95.3(g). Investigation is ordinarily conducted by the Civil Service Commission. The FBI conducts the investigation only with respect to positions designated by a majority of the members of the Commission as being of a "high degree of importance or sensitivity" or if the Civil Service Commission investigation develops derogatory information bearing upon loyalty considerations. §145(c)-(e), 68 STAT. 943, 42 U.S.C.A. §2165(c)-(e) (Supp. 1954).

[29] The AEC's Personnel Security Clearance, Criteria for Determining Eligibility, 15 FED. REG. 8093 (1950), requires that the nature of the individual's position and access to Restricted Data be considered in making the ultimate security determination. It is, however, well known to those sophisticated in government security programs that the security standards are rarely applied on a basis varying with actual sensitivity of the individual's position.

[30] See Personnel Security Clearance Procedures, 15 FED. REG. 6241 (1950).

ance creates a so-called "gray area" within which industry would not be bound by clearance procedures as restrictive as if "Q" clearances were universally required.[31] This is an exaggerated statement of the effect of the "L" clearance program. Industry still requires security clearance for access to Restricted Data. There are, however, two differences flowing from the disparity in scope of the investigations required for "L" and "Q" clearances. In the case of a "Q" clearance, the requisite background investigation.necessitates a lapse of at least three to four months between the time clearance is requested and the time it is finally granted. In the case of an "L" clearance, the investigation is much briefer, and clearance can be granted within three or four weeks.[32] It is this factor of time lag and ease of getting cleared personnel on the job which makes the big difference from industry's standpoint. A second factor, particularly if industry must bear the costs of clearance of its personnel, is that an "L" clearance is much less expensive.[33]

The circle of individuals authorized to have access to Restricted Data embraces two distinct groups. Individuals who participate in government programs relating to atomic energy as government employees or as employees of government contractors who require access to Restricted Data in performance of their duties may have such access after they are cleared. The manner in which Restricted Data is controlled within this part of the circle is a matter of internal government procedure and is beyond the scope of this paper. We are primarily concerned with the second group—individuals who receive access to Restricted Data in order to help them or their employers develop and exploit civilian applications of atomic energy. Restricted Data is made available to these individuals under the AEC's Access Permit Program.

The Access Permit Program operates at two levels. On the first level, the Commission will provide access to Confidential Restricted Data, on a very broad basis, to any person who can evidence a legitimate economic interest in the information in terms of some potential use or application in his business, trade, or profession.[34] A Confidential access permit will permit access to any Confidential Restricted Data relating to civilian uses of atomic energy which is not primarily of military significance.[35] Such access would probably be sufficient to enable at least a preliminary judgment as to whether or not the firm or individual concerned wishes to engage in atomic energy activities involving classified technology, and in many instances, it might in itself provide sufficiently complete information to enable com-

[31] See, for example, Beckerley, *The Impact of Government Information and Security Controls on Competitive Industry*, 11 BULL. OF THE ATOMIC SCIENTISTS 123, 127 (1955). Under the Atomic Energy Act of 1946, there was only one type of clearance possible for access to Restricted Data—the "Q" clearance.

[32] The time estimates are taken from an address by Mr. Charles G. Manly, of the AEC's Division of Civilian Application, before a meeting of the Committee on Atomic Energy Procurement of the Machinery & Applied Products Institute in Washington, D. C., July 27, 1955.

[33] The AEC allows each firm twenty-five free security clearances and will bill the firm $15 for each additional "L" clearance requested and $265 for each additional "Q" clearance requested. *Ibid.*

[34] Proposed AEC Regulations on Access to Restricted Data §25.8(a)(1), 20 FED. REG. 3634 (1955).

[35] *Id.* §25.1.

mencement of such activities. On the second level, Secret Restricted Data will be made available on a narrow basis only, and only to an applicant who can demonstrate that specific and limited Secret information has an "immediate or significant effect" on his business, trade, or profession.[36] In this respect, the AEC seems to be establishing a new form of "need to know"—"need to know" to carry on private activities for profit.[37]

Confidential and Secret access permits have a number of features in common. Under both types of permits, actual access is limited to persons with appropriate security clearance—"L" clearance in the case of Confidential access and "Q" clearance in the case of Secret access;[38] the applicant must agree in writing to conform to all AEC security regulations[39] and must submit proposed procedures for safeguarding the Restricted Data for AEC approval;[40] and those given access will be required to reimburse the Commission for readily identifiable cost of services rendered by the Commission in connection with the agreement, including the costs of clearance and of publications or documents furnished.[41] There is one significant difference, however. In the case of Confidential access permits, the Commission does not reserve any rights to inventions and discoveries arising from the access, while in the case of Secret access permits, the Commission retains the right to use inventions or discoveries arising from the access on a royalty-free, non-exclusive basis.[42]

Those holding Confidential or Secret access permits may obtain access to Restricted Data within the scope of their permits from private persons as well as from the AEC directly. As the Director of the AEC's Division of Civilian Application put it:[43]

> after the personnel security clearances have been obtained, the permittee may obtain the restricted data for which he has been given a permit anywhere he can find it—AEC contractors, other AEC permittees, and Commission offices.

Any person possessing Confidential Restricted Data pertaining to civilian applications of atomic energy may permit any individual in his own company or elsewhere who has an "L" or a "Q" clearance to have access to such information.[44] Secret Restricted Data may be made available to any individual within his company who requires access in the performance of his duties.[45] But Secret Restricted Data may

[36] *Id.* §25.8(a)(2).

[37] Charles G. Manly, of the AEC's Division of Civilian Application, stated in an address before the Atomic Industrial Forum in San Francisco on April 4, 1955: ". . . the Atomic Energy Commission now accepts a purely commercial interest . . . as sufficient 'need to know' to warrant access to Confidential Restricted Data."

[38] Proposed AEC Regulations on Access to Restricted Data §25.10, 20 FED. REG. 3634 (1955).

[39] *Id.* §25.9(c)(1).

[40] *Id.* §25.11(b).

[41] *Id.* §25.9(c)(2); see note 33 *supra.*

[42] Proposed AEC Regulations on Access to Restricted Data §25.9(b), 20 FED. REG. 3634 (1955).

[43] Address of Harold L. Price, Director of AEC's Division of Civilian Application, before the Atomic Industrial Forum in New York City, May 24, 1955.

[44] Proposed AEC Regulations for the Safeguarding of Restricted Data §95.31, 20 FED. REG. 2495-96 (1955).

[45] *Ibid.*

not be made available to any other individuals except as specifically authorized by the AEC.[46] This means that whenever an inter-firm exchange of Secret Restricted Data is contemplated, the parties must communicate with the AEC for permission to exchange the information.

The AEC's public statements and its proposed regulations issued to date set forth only the bare outlines of the regulatory scheme within which the classified atomic energy technology will be made available to American enterprise. They avoid, it would seem almost deliberately, the many serious and vexing problems inherent in the effort to mesh security control over technological information with use of information so controlled for private purposes. The information control mechanism forged in the Atomic Energy Act of 1954 and the opening of the atomic energy technology to private enterprise add a new dimension to the problem of effective security and compel serious thought about the impact of security upon the economy.

II

SOME PROBLEMS RAISED

Some major problems become apparent as we move forward into the era of a private atomic technology which will be based, to a large extent, upon private use of national secrets. What follows cannot be a complete discussion of the total implications of the information control structure, since each problem which is stated suggests a host of subsidiary or ancillary problems. These problems, moreover, are necessarily discussed in abstract terms, on the basis of the limited official statements and proposed regulations issued to date. In any event, time and actual experience in implementing the information control system will undoubtedly bring to light additional major problems and add an important gloss to the problems discussed in this paper.

The Scope of Access Which Will Be Permitted Under Access Permits

Under normal circumstances, any firm has available to it all the information necessary for it to compete effectively, assuming it has adequate personnel and resources, in the race for new or improved products or techniques. The only impediment to development and exploitation of new ideas rests in the patent system. In the new atomic energy industry, however, technological information is not readily available to all those who are willing to dig for it, but is, to a very significant extent, available only subject to the dispensation of the Government. The Government has, therefore, a great responsibility to assure that the atomic energy information control system is administered in an equitable manner which will discriminate neither in favor of nor to the detriment of individual firms.

The problem of assuring equitable dissemination of Restricted Data is greatly complicated by the present structure of the atomic energy industry—a structure which undoubtedly will persist into the foreseeable future. A number of firms have

[46] *Ibid.*

had substantial and comprehensive access to Restricted Data for many years in their roles as government contractors or under AEC study arrangements and have large pools of personnel who have acquired substantial classified know-how. At the other extreme, many firms aspiring to a role in the coming atomic era have had very little or no access to Restricted Data. Even among the former group, there are marked variations in the degree of classified know-how possessed, depending upon length of participation in atomic energy programs, scale of activities, and degree of diversification of the projects in which involved. Indeed, many of these firms undoubtedly already possess sufficient classified know-how to proceed with profit-seeking ventures in the atomic energy field without dependence upon the AEC for further access to Restricted Data. Competition for atomic energy profits is, therefore, commencing under circumstances involving substantial inequities in access to the classified technology. This situation appears to be an unavoidable consequence of the decision to open the atomic energy field to private enterprise. The competitive inequities are somewhat mitigated by the provisions of the Atomic Energy Act of 1954 intended to preclude the development of a patent monopoly during the transitional period,[47] but even without the ability to secure a monopolistic patent position, the "haves" possess the opportunity to outstrip the "have-nots" in developing markets for atomic energy applications. Moreover, similar and additional advantages will continue to accrue in the future to those firms which participate under contract in the various programs conducted by the AEC. They will receive access to Restricted Data as an incident to their work for the AEC, for which, of course, they are compensated, and some of this information may be of the type which will not be available to other firms under access permits.[48]

The AEC's approach to information control does not reflect consideration of the problem of these initial inequities, which, in any event, may be insoluble. Rather, the AEC appears to accept the *status quo* and concentrates its attention upon assuring future equality of access among the "have-nots," without regard to the advantages already possessed by the "haves." But even this policy involves impediments to the ultimate redressing of the inequities.

[47] Sections 152 and 159 of the Atomic Energy Act of 1954, 68 STAT. 944, 948, 42 U.S.C.A. §§2182, 2189 (Supp. 1954), bar the issuance of patents for atomic energy inventions made or conceived under any "contract, subcontract, arrangement, or other relationship with the Commission" or during the course of any federally financed operations, unless the AEC waives its rights to such patents. Section 153, 68 STAT. 945, 42 U.S.C.A. §2183 (Supp. 1954), provides for compulsory licensing of important privately owned atomic energy patents under certain specified circumstances as the AEC deems appropriate under the statutory standards. The compulsory licensing provisions apply to patent applications filed during a transitional period ending September 1, 1959, by which date, presumably, the initial advantages of the "haves" will be greatly diminished.

[48] There is no effective means for compartmentalizing and separating Restricted Data acquired by a firm through AEC contract activities from Restricted Data acquired by it under an access permit. Nothing precludes a firm's use of Restricted Data, acquired by it in performance of an AEC contract, in connection with private exploitation of civilian applications of atomic energy under an AEC license. Indeed, there are undoubtedly many firms which can acquire in their contract activities all the Restricted Data which they possibly would require for effective conduct of AEC-licensed activities, so that they would never need an access permit as the basis for obtaining Restricted Data necessary for exploitation of civilian applications of atomic energy.

The AEC's proposed regulations contain three major restrictions upon the scope of Restricted Data to which access will be afforded under the Access Permit Program. Access to Restricted Data will be permitted only if it relates to civilian uses of atomic energy and is not "primarily of military significance";[49] Secret Restricted Data will be made available only on an extremely limited basis and only to those who the AEC decides "really need it";[50] and Top Secret Restricted Data is wholly excluded from the scope of access permits. These limitations, if they are to be regarded as effective, appear at first glance to be thoroughly reasonable, but they are, in fact, discriminatory. As will be pointed out, however, there is serious question whether these limitations can really be enforced by the AEC, and, if they are not enforceable, the discriminations discussed in the following paragraphs may not, in fact, be as serious as they would otherwise appear.

The line between civilian and military applications is, at best, a hazy one. Many areas of information which are, at any point of time, of primarily military significance also have substantial civilian application,[51] and as time goes on, the relative degree of civilian significance is likely to increase. If, for example, the AEC chooses to regard Restricted Data relating to nuclear propulsion as "primarily of military significance" because of its present importance to military aircraft and naval vessels,[52] the practical effect will be to exclude entry into these fields by additional firms interested in private research on and development of nuclear propulsion. It will also strengthen the competitive position of the firms now working in these fields under government contracts in connection with the ultimate development and sale of nuclear propulsion units for civilian application in locomotives, merchant vessels, motor vehicles, and aircraft. Similarly, the exclusion of Top Secret Restricted Data from dissemination to access permittees precludes some firms from working with important technological information—usually of the most advanced nature—while other firms have access to the same data as AEC contractors and are able, as a practical matter, to use the data in the competitive race for civilian markets.[53]

[49] Proposed AEC Regulations on Access to Restricted Data §25.1, 20 FED. REG. 3634 (1955).

[50] It is clear that dissemination of Secret Restricted Data will be stringently limited. The AEC regards Secret Restricted Data as "particularly sensitive" and "will not permit it to be disseminated except to individuals who really need it." Address of Harold L. Price, *supra* note 43. The AEC has also indicated that access to Secret Restricted Data will always be limited "to only a few." Address of Charles G. Manly, *supra* note 37. A further indication of the AEC's attitude with respect to Secret access permits may be sensed in considering the statement that: ". . . a company usually has trouble showing that secret data will have an immediate or significant effect on their business until they have exhausted the confidential information available." Address of Charles G. Manly, *supra* note 32.

[51] A leading authority on the content of Restricted Data, the former AEC Director of Classification, has stated: "I know of techniques important to atomic weapons manufacture and therefore highly classified which some clever individual might be able to turn to commercial use." Beckerley, *supra* note 31, at 126.

[52] In this connection, it is noteworthy that certain bilateral agreements for cooperation with other nations in atomic energy matters entered into by the AEC specify that "the development of submarine, ship, aircraft, and certain package power reactors is presently concerned primarily with their military uses," and, therefore, beyond the scope of the agreements providing for exchange of information on civilian applications. See texts of Proposed Agreements for Cooperation Concerning the Civil Uses of Atomic Energy between the United States and Belgium, the United States and the United Kingdom of Great Britain and Northern Ireland, the United States and Canada, S. REP. No. 1051, 84th Cong., 1st Sess. 18 (1955).

[53] See note 48 *supra*.

Much the same analysis applies to dissemination of Secret Restricted Data. The AEC will undoubtedy exert pressure to persuade applicants for Secret access that they should try to find their information in the Confidential literature.[54] If a Secret access permit is issued, it will authorize access within one or more specifically requested categories of Restricted Data to be established by the AEC. As a practical matter, however, a particular firm may not grasp the significance or relationship to its project of certain areas of Secret information, which it may not even know exists, while other firms may already have the Secret information or knowledge of its existence through work as AEC contractors or through acquisition of personnel who have been engaged in such work. Similarly, a firm may request access to a specific area of Secret data and be denied access on the basis of a bureaucratic determination that it does not really need such information, while an identically situated firm may be more successful.

A variation of the same problem may be found with respect to access to Confidential Restricted Data. The AEC has indicated that it is reviewing various reports and documents in the field of civilian applications and that these materials will be listed in a catalogue, printed, and made available for sale to permittees.[55] But the AEC cannot hope to include in such reports all extant Restricted Data on civilian applications.[56] This means that some firms which have been in the atomic energy program for a time will have available pieces of Confidential Restricted Data that would not be available to other firms through the use of the AEC's catalogue and published reports. Such other firms may or may not be able to obtain such unpublished Confidential Restricted Data, depending upon their luck in finding people who happen to have the data and who are willing to make it available.

Sound and conscientious administration of the Access Permit Program would undoubtedly narrow the area and frequency of discrimination and inequality. Indeed, it must be recognized that it is rarely possible for a sovereign to treat identically situated persons in a precisely identical manner. There are, inevitably, variations leading to some degree of discrimination, usually an insignificant degree if administration is sound. But we are dealing here with technological information, which in a normal economic situation is freely available to access. Government-imposed restraints upon the flow of information are, in essence, abhorrent. Total restrictions upon access to information have been tolerated in the interests of national security, but restraints unevenly applied as among competing firms are another matter. Access to Restricted Data is the immediate gateway to the atomic future of American industry. The slightest deviations in equality of access to Restricted Data may be of the most profound immediate and long-run significance to the economic status of the

[54] See note 50 *supra*.

[55] Address of Charles G. Manly, *supra* note 32.

[56] The classified reports which will be made available by the AEC are largely "pin-point" research reports rather than generalized or comprehensive assessments of methods, approaches, and outlook. Permittees will have to "examine stacks of reports, here and there select and evaluate bits of information, and make their own analyses." *Ibid*.

firm affected, to the relative position of competing firms, and to the basic structure of our future atomic economy. The situation is rendered all the more serious by the fact that these deviations are created by the Government through application of vague and subjective standards.[57]

These problems are functions of the manner in which the 1954 act is administered rather than of deficiencies in the act itself. Congress did not blueprint the pattern for dissemination of Restricted Data for use by private enterprise, but merely established a set of contrary principles for security control and industrial dissemination, leaving the AEC virtually absolute flexibility in implementing these principles.

The AEC's approach to implementation of these contrary principles represents a peculiar blend of the considerations involved. In so far as concerns Confidential Restricted Data on civilian applications of atomic energy not primarily of military significance, there is an almost complete abandonment of the "need-to-know" concept. This minimizes the problems of discrimination in access but makes effective security control quite difficult. There is reason to believe that the AEC expects that Confidential Restricted Data disseminated so widely will be compromised and declassifiable within a relatively short time but regards continuation of information control during this marginal period as important.[58] Secret Restricted Data, however, is disseminated only on a fairly stringent "need-to-know" basis, although purely commercial "need to know" is recognized. Top Secret data is disseminated only on an absolute "need-to-know" basis and is not made available for commercial use. Thus, there is a serious effort to maintain genuine security and a corresponding increase in the inherent potential discrimination.

It is readily apparent that the traditional concept of free competition requires free entry to the market place. The necessity for effective security cannot be reconciled with this traditional concept. The attempt to maintain effective security and, at the same time, spur private development and exploitation of atomic energy inevitably gives rise to serious questions of political and economic policy and of justice, and these questions are particularly troublesome because of their impact upon the basic structure of what will be a basic and important American industry.

The Restricted Data Fantasy

In some important respects, the AEC's approach to information control reflects a lack of realism bordering upon fantasy. Nowhere is this lack of realism more

[57] The AEC's proposed regulations do not contemplate that there will be "due process" in the AEC's handling of access permit applications and related questions. The act expressly provides for hearings and judicial review only in connection with proceedings for the granting, suspending, revoking, or amending of any license. §189, 68 STAT. 955, 42 U.S.C.A. §2239 (Supp. 1954). Although the act does not in any sense mention access permits, however, it is clear that an access permit is the equivalent of an atomic energy license, and, in many respects, access permits may be of greater economic importance than licenses expressly provided for in the act. Nevertheless, the Proposed AEC Regulations on Rules of Practice, 20 FED. REG. 5786 (1955), provide for hearing procedures only with respect to licenses expressly referred to in the act.

[58] Continuation of information controls gives the AEC a valuable bargaining asset in connection with negotiation of bilateral agreements for cooperation with other nations.

apparent than in the AEC's apparent assumptions about the creation and circulation of Restricted Data.

Implicit in the proposed information control regulations are the assumptions that Restricted Data can be neatly packaged and dispensed; that persons may lawfully possess Restricted Data only if authorized by the AEC; that dissemination of Restricted Data may be confined within AEC-controlled channels; and that lawful access to Restricted Data may be terminated when the authorization for access expires. These assumptions all collapse when it is recognized that the creative mind of man is able, independently and without AEC assistance, to originate and develop information falling within the Restricted Data definition. A firm which has never had an AEC contract or an access permit and none of whose personnel has ever had access to Restricted Data may, nevertheless, create information falling within the Restricted Data category. Similarly, a firm which has an access permit and is, therefore, authorized to have access to some Restricted Data may originate Restricted Data of a type beyond the scope of the permit's authorization. Thus, a permittee may originate Restricted Data of a type which he is not authorized to possess because it is primarily of military significance, or Top Secret Restricted Data, or Secret Restricted Data not authorized under the access permit.

An AEC license is not required to originate new ideas in the atomic energy field. No law or regulation is violated if a firm develops Restricted Data notwithstanding that it does not have an access permit authorizing access to the data created. But once the Restricted Data comes into existence, it becomes subject to the entire array of information control provisions of the Atomic Energy Act of 1954 to precisely the same extent as if the data had been developed in an AEC laboratory.[59] A firm

[59] In the recent *Hearings, supra* note 23, Senator Humphrey, Chairman of the Subcommittee, questioned the AEC's General Counsel, Mr. William Mitchell, about the situation which would arise if a scientist independently developed and wished to publish energy information falling within the Restricted Data definition. The following colloquy ensued (at 268-70):

> Mr. MITCHELL. I am assuming that this scientist knows that the information that he has developed and is publishing falls within the category of restricted data. . . . I think when this came to our knowledge, we would immediately call to his attention the fact that this information does fall within this area, and we would call to his attention the need for safeguarding it, and not passing it on to people who were not entitled to receive it.
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> . . . .
>
> Senator HUMPHREY. If he were going to continue his investigation, he would have to be cleared?
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> . . . .
>
> Mr. MITCHELL. I think he would.
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> . . . .
>
> Senator HUMPHREY. What about his publishing these ideas?
>
> Mr. MITCHELL. Well . . . I would say that at this point, he is on notice, that the kind of thing he is doing not only the information he already has developed but the information that he may continue to develop falls within this area. Then I think he is on notice that if he passes this new information on to people who are not entitled to receive it, I would think that this would be a knowing revelation.
>
> Senator HUMPHREY. . . . Let us assume . . . that he cannot get a security clearance. That he joined something that he should not have joined. He does not get a security clearance. So you cannot hire him. You cannot have anything to do with him. What do you do with this fellow? He is a scientist. He has a laboratory. He likes to work in his laboratory. He researches and he produces and he publishes. What do you do with him in America?

which originates such Restricted Data, even if it was developed wholly without government assistance or connection, must then become concerned with classification stamps, investigations, clearances, safes, and other trappings of security, and severe security restrictions are placed upon the flow of the firm's ideas. The firm finds itself propelled, involuntarily, into a security vortex of considerable economic significance.

The fact that Restricted Data may be independently originated demonstrates clearly that the AEC has no real power to deny or control access to Restricted Data. If, for example, it refuses to grant an access permit for certain Secret Restricted Data on the grounds that the data does not have an immediate or significant effect upon the applicant's business and that the data is primarily of military significance, the applicant may completely circumvent the AEC's refusal by developing the very same information itself without obtaining the data from the AEC or from other firms which have the information. Indeed, it can do this speedily and effectively simply by hiring away from other firms personnel skilled in the particular classified technology. Such personnel could not bring classified materials with them, and they would lose their AEC clearances when they changed jobs. They would, moreover, be precluded from discussing Restricted Data with or communicating Restricted Data to the officials and other employees of their new firm unless such officials and employees had clearance and authorization for such access. But there is nothing to prevent or prohibit their using their minds' store of Restricted Data to develop atomic energy plans and ideas. It is not conceivable that the AEC could find statutory authority or would find it wise as a matter of policy to refuse to clear officials and other employees of the firm and authorize them to have access to Restricted Data developed by the firm's own personnel at its own expense so that the firm could have the benefit of this work.

Thus, a firm denied access to Restricted Data may easily present the AEC with the *fait accompli* of having achieved its purposes legally without AEC authorization. It would have a body of Restricted Data available to it and a pool of cleared personnel to work with the data. The AEC would then have no sound basis for refusing to permit the firm to discuss this type of information with other firms

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Mr. MITCHELL. So far as I know, we have never run into this situation. If we did, I would say that if this man is on notice that the things that he is doing have an important impact on our national defense and security, and if he chooses in spite of this knowledge, to pass this information on, to people who are not entitled to receive it, then he quitely [*sic*] properly becomes subject to the criminal provisions of the law. . . .

Senator HUMPHREY. In other words, you could really put him in jail?

Mr. MITCHELL. I think we could.

. . . .

Senator HUMPHREY. This is an intriguing proposition, if you pardon me for saying so. You know you do run into people that are just sort of unorthodox. . . . You get one that is very wise, able, intelligent, and brilliant. He comes up with some discovery in a private installation. Maybe he worked all of his life to build his own laboratory. What if he just does not like all of your regulations?

Mr. MITCHELL. That is right.

Senator HUMPHREY. But you could force him to shut up?

Mr. MITCHELL. Yes, sir.

working in the field or for refusing to permit access to pertinent Restricted Data directly from the AEC.[60] In other words, the circumstances would, in all probability, compel the AEC to grant the very access permit which it had previously denied. If it does this, there would be no basis for refusing to grant similar access permits to other applicants who are in a situation similar to the initial one of the firm which circumvented the restrictions.

A related problem is that of the limited term of access permits. Under the proposed access regulations, access permits will generally be issued for a period of one year, subject to renewal, and Secret access permits may be issued for even shorter periods.[61] During the period of the permit, the permittee will be able to obtain Restricted Data from the AEC and from other firms and to purchase numerous classified documents. The permittee will, presumably, also create numerous internal documents reflecting or extending the classified information acquired from external sources. What happens to this store of Restricted Data if the access permit expires and the permittee does not seek renewal?[62]

The AEC's proposed regulations do not indicate how the security interest in a firm whose access permit terminates will be liquidated in the face of the permittee's acquisition of a substantial proprietary interest in Restricted Data. Although the AEC could conceivably require the return of all classified documents obtained from external sources, it is doubtful that it could compel surrender of the firm's original documents. There is, moreover, no way to purge the firm of its classified know-how stored in the minds of its personnel. Undoubtedly, the AEC will insist that its security regulations remain in effect, just as if the access permit were still in force, to protect the Restricted Data in the hands of the former permittee.[63] Similarly, it is almost certain that all security clearances would remain in effect and that additional clearance requests by the firm would be processed by the AEC to avoid the anomaly of uncleared personnel having access to the firm's Restricted Data. On the other hand, if the clearances are permitted to remain in effect, it is unlikely that

[60] Nothing in the Atomic Energy Act of 1954 precludes the issuance of a license for atomic energy activities based upon Restricted Data outside the scope of the Access Permit Program. Thus, a firm which develops or otherwise possesses Top Secret Restricted Data, or data of primarily military significance, which wishes to obtain a license for civilian applications based upon such data, may apply for a license and would be entitled to have its application considered on precisely the same basis as if it involved only Restricted Data to which access was authorized under the AEC access regulations.

[61] Proposed AEC Regulations on Access to Restricted Data §§25.8(a)(2), 25.12, 20 FED. REG. 3634 (1955).

[62] It is not at all inconceivable that a permittee may conclude that it does not wish to renew its access permit if it can lawfully continue to work with Restricted Data without it, since it may regard the conditions attached to the permit as unduly onerous. A permittee must agree, for example, as a condition of the permit, to waive certain patent claims in connection with inventions or discoveries made or conceived in the course of, in connection with, or under the terms of the permit and to grant an irrevocable, royalty-free, non-exclusive license in and to report to the AEC any invention or discovery made or conceived as the result of access to Secret Restricted Data under the permit. Proposed AEC Regulations on Access to Restricted Data §25.9(c), 20 FED. REG. 3634 (1955).

[63] See Proposed AEC Regulations on Safeguarding of Restricted Data §95.2, 20 FED. REG. 2495 (1955). This is applicable to all persons within or under the jurisdiction of the United States, and not merely to persons possessing Restricted Data under some form of AEC authorization.

the AEC could prevent cleared personnel of the firm from discussing Restricted Data with other firms, thereby expanding its store of classified know-how.

It is difficult to understand how termination of an access permit can substantially affect a firm's position with respect to Restricted Data. It would appear that once a firm achieves the status of having authorized access to Restricted Data, its status cannot be easily undone. It remains to be seen whether the AEC will find a realistic formula for distinguishing between those firms which continue to renew and those firms which choose to abandon their permits. This is, in a sense, the acid test of the efficacy of the AEC information control mechanism, since if a firm can retain many of the advantages of an access permit even though it renounces its permit, the entire Access Permit Program becomes almost an absurdity.

The Problem of Clearance

The AEC's access program provides a means for controlling the dissemination of Restricted Data to individuals with appropriate security clearance. A further control is exercised by the AEC in determining who is to be cleared. The access program operates directly upon the firm, and only indirectly upon the individual employee; the clearance program operates directly on the employee, and only indirectly upon the firm. But the impact of the clearance program upon the relative position of competing firms is by no means insignificant. A clearance problem may seriously retard or prevent entry of a firm into classified areas of the atomic energy industry or may adversely affect its competitive position within the industry, especially where it is a small firm or where an unclearable employee is essential to the firm's atomic energy activities. As a corollary of this, possession of AEC clearance or a pool of cleared personnel is a most valuable asset in that it greatly expands the economic potential of both the cleared individuals and the firm. Possession of clearance means that one can act to take immediate advantage of classified opportunities. An individual or firm without clearance cannot always move to capitalize on such opportunities. The most that can be done in many cases is to mark time while a clearance application is being processed, during which interval competitors who already have clearance status are actively engaged in taking advantage of the opportunity.

Two distinct steps are involved in the clearance process. The first step is the AEC's decision to process an application for clearance. The second step is the determination that clearance should be granted in the light of the results of investigation. Both of these steps involve considerations of the utmost importance to private enterprise engaged in atomic energy activities.

The Government has never been generous in dispensing security clearance. Under traditional security practices, the principle of "need to know" has been applied mainly in the initial granting of clearance rather than in the actual dissemination of classified information. There was no such thing as a "general" security clearance authorizing access to classified information generally. Clearance applications were

never processed just because an individual wanted a clearance in case he might need it or because it would help in getting classified work. Clearance applications were usually entertained only when someone already within the circle of cleared persons engaged in work for the Government would request clearance of an individual so that he might participate in a specific classified government project. Once the individual was initiated into the cleared circle, his clearance would, as a practical matter, enable him to have access, without further determination, to other classified matter than that for which the clearance was initially granted. As soon as the need for access to classified matter for performance of work on government projects ceased, the clearance was, theoretically at least, terminated.

This was precisely the pattern of the AEC clearance program in less complicated days when the AEC did not have to be concerned with making Restricted Data available for private exploitation. Under present conditions, however, the rules are quite different. The Commission will now process for "L" clearance almost any individual who can show that there is a potential use for Restricted Data in his business, profession, or trade. After "L" clearance is granted, it suffices for access to any Confidential Restricted Data without regard for the "need-to-know" principle.

The requirements for "Q" clearance are more severe. "Q" clearance may be granted to private persons for exploitation of Secret atomic energy technology only under an access permit. A Secret access permit will be granted only for specific areas or information having an immediate or significant effect upon the applicant's business, profession, or trade and only for definitely limited periods of time. Thus, "Q" clearance for access to Secret Restricted Data is linked to a severe "need-to-know" test, although the "need to know" may now relate to private profit-seeking activities as well as to government projects. This means that firms which cannot show a "need to know"—*i.e.*, that the information requested has an immediate or significant effect—will not be able to get a Secret access permit or a "Q" clearance. When a business opportunity does arise in which Secret Restricted Data would have an immediate or significant effect, the firm may apply for "Q" clearance for its personnel and expect to receive the clearances in three or four months if all goes well. Meanwhile, the opportunity may have been captured by someone with a clearance status which permitted immediate action.

This suggests the strong desirability of divorcing the processing of clearance applications from access permits and the "need-to-know" doctrine. It would make sense for the AEC to process for "Q" clearance anyone requesting it who could show that such clearance might be of potential value to him. The "need-to-know" principle could then be applied to actual access to Restricted Data rather than to the grant of clearance. For example, the "Q" clearance could be held in inactive suspense until a "need to know" arises, at which time, it could quickly be made active. Such a policy would be in no way inconsistent with principles of effective security; indeed, it would make for more effective security, since application of the "need-to-know" doctrine would be more realistic and efficient.

The second step in the clearance process is the determination whether the applicant is worthy of clearance. This determination is part and parcel of the over-all problem of government personnel security programs, which has been very much discussed in the past several years. But the atomic energy information control system carries the personnel security clearance concept into new ground, raising new questions of law and policy, since AEC security clearance is substantially equivalent to a license for employment in the atomic energy industry.[64] The opportunity for private employment has long been recognized as a right subject to the protection of the "due process" clauses of the fourteenth and the fifth amendments to the Constitution of the United States.[65] It is a certainty, because of the economic significance of AEC clearance, that the clearance requirements for access to Restricted Data by employees of private enterprise will, sooner or later, be subjected to court tests. It remains to be seen whether the courts will countenance, as they have in the cases of government employees, disposition of important rights to private employment under the vague standards and loose procedures, falling far short of "due process," which are characteristic of the present-day security clearance systems.[66] Judicial rejection of the AEC clearance system as applied to employees of private enterprise engaged in private exploitation of atomic energy applications would throw the entire information control system into absolute chaos.

III

CONCLUSION

The above discussion clearly demonstrates the difficulties found in rational application of security controls to areas of economic activity entrusted to the play of private enterprise. Problems of information control were relatively simple when they arose only in the context of government operations and programs, where the Government's control was absolute and it did not have to be overly concerned about

[64] Theoretically, security clearance is required only for access to Restricted Data and not for employment in the atomic energy industry. Denial of clearance means only that the individual may not have access; it does not mean that the employer must remove him from unclassified atomic energy work. As a practical matter, however, an unclearable employee is a handicap to his employer, since the employer is deprived of flexibility in the assignment of the employee to areas of work and the employer must take extraordinary pains to keep a security risk away from any possible area of security interest. In addition, an employer interested in classified atomic energy activities might understandably be reluctant to retain an employee who is *persona non grata* with the AEC for security reasons. At the very best, denial of AEC security clearance would greatly diminish an individual's economic opportunity in atomic energy.

[65] See Meyer v. Nebraska, 262 U.S. 390 (1923); Cummings v. Missouri, 71 U.S. 277 (1886); United States v. Gray, 207 F.2d 237 (9th Cir. 1953); Parker v. Lester, 112 F. Supp. 433 (N.D. Cal. 1953).

[66] In the cases of government employees, the theory that no person has a right to a government job has been decisive, since if there is no "right," there is no deprivation to which the "due process" requirement attaches. It has, however, been recognized that deprivation of the right to private employment in the merchant marine under the Government's port security program (which is analogous to the personal security programs) must be accomplished in accordance with "due process." On October 26, 1955, the United States Court of Appeals for the Ninth Circuit held in Parker v. Lester, *reversing* Parker v. Lester, *supra* note 65, that a merchant seaman must be afforded the elements of due process, including the opportunity to confront and cross-examine those furnishing derogatory information against him, before he may be denied employment on security grounds. See 24 U. S. L. WEEK 2203-04 (U. S. Nov. 8, 1955).

equity, discrimination, due process, and the effect upon competitive forces.[67] Application of security principles developed in this context has now been uncritically transferred to the sphere of competitive free enterprise. It has been assumed that the standard principles hitherto applied can be carried over almost intact, and with only minor tinkering, to this new sphere. This assumption has been clearly articulated by the AEC:[68]

> The proposed regulation dealing with the safeguarding of Restricted Data is pretty much an adaptation of information control procedures which have been in effect within the Commission program since its beginning. . . .

There is considerable question whether simple adaptations of conventional information control procedures can adequately meet the needs of either private enterprise or security.

The AEC's approach to information control in atomic energy development assumes that access to Restricted Data will be granted by a paternalistic government which, with due regard to the requirements of national security, industrial progress, and principles of equity, will make fine distinctions among competing firms and types of information. The impersonal objectivity of the market place would be replaced by the whimsical subjectivity of a bureaucracy riding the horns of an insoluble dilemma in governing access to the atomic energy industry. If the AEC's proposed regulations embodying this structure of information control are to be taken seriously, there can be no result other than the lessening of competition, the encouragement of monopoly, the introduction of rigidities into the economy, and serious discrimination against those firms which, for one reason or another, cannot meet the bureaucratic tests. If the information control structure is, in fact, what it purports to be, one can only hope that sound and conscientious administration by the AEC will lessen the intensity and extent of these evils.

But, as pointed out above, it is possible that the basic discriminatory restrictions upon private enterprise's access to Restricted Data may be lawfully circumvented almost at will. If this is true, the evils inherent in the information control structure are drastically reduced, in the long run at least, since any firm which really wants access to Restricted Data and has the requisite ingenuity and resources can accomplish its objective despite the restrictions. But it remains a serious problem that the discriminatory restrictions on access will be effective in the short run—during the formative infancy of the atomic energy industry—until the pattern for circumvention has been demonstrated and accepted.

There is another important problem presented by the contemplated structure of information control. This is the problem of preserving the integrity of the AEC security mechanism itself. The integrity of the security mechanism is considerably

[67] In the context of conventional security programs, the only problems of equity and discrimination center upon selection of particular firms for work on classified government projects, and there is little direct impact upon nongovernment activities.

[68] Address of Charles G. Manly, *supra* note 32.

weakened by abandonment of the "need-to-know" criterion with respect to Confidential Restricted Data and its attenuation with respect to Secret Restricted Data. It is, moreover, doubtful that the AEC can hold the line established in its proposed regulations. Whenever an applicant for Restricted Data is denied access as required by the regulations, the applicant would undoubtedly be justified in raising the cry of "discrimination" since it will never be difficult to find another firm which is using the same Restricted Data. It cannot be expected that a government agency will not yield in the face of such pressures. Beyond this, if it is a correct hypothesis that restrictions upon access to Restricted Data may be easily circumvented, it is most doubtful that the AEC will ever be able to deny access to any type or classification of Restricted Data to any applicant who really wants it, except possibly to applicants who cannot meet the security clearance tests. Never before has the security mechanism encountered persistent, erosive resistance such as it will now face as competitive enterprise seeks to exploit every crack and crevice in the security armor to avoid and evade restrictions barring the path to profit-seeking activities. This presages a complete collapse of the security mechanism.

The AEC has rushed headlong into the new experiment in information control without full and adequate consideration of its implications. A problem of this magnitude and novelty, involving not only questions of economic and legal policy and effective security, but also problems of essential freedoms of man, should not be entrusted to the discretion of the government agency whose gropings for a reasonable solution lead inevitably to questionable decisions which may not be easily rectified in the light of hindsight. The dilemma of information control—the reconciliation of the needs of national security with the desire to encourage industrial development of atomic energy—should, instead, be resolved as a matter of considered national policy after full study of all issues involved.

SOME PATENT ASPECTS OF ATOMIC POWER DEVELOPMENT

BENNETT BOSKEY*

In these early years of the Atomic Revolution, a mood of transition is widely manifest. This mood helps to sustain our hopes for achieving, through the atom, not annihilation, but, instead, the vast betterment of all mankind. It affects the scope and the pace of our industrial activities. It exerts its influence on the course of our diplomatic negotiations, as well as on the programs of our great institutions of learning. And, needless to say, it is reflected in the Atomic Energy Act of 1954,[1] the statute which sets the legal bounds of our atomic energy endeavor.

When this important congressional enactment became the law on August 30, 1954, the event marked the end of one era and the beginning of another in the atomic energy policy of the United States. A primary aim of the new act was to terminate the tight Atomic Energy Commission monopoly which the Congress had established in the original Atomic Energy Act of 1946.[2] This was in recognition of the fact—though it was by no means a simple fact—that the changes occurring between 1946 and 1954 had gradually made it clear that, if continued, the AEC monopoly would become a national liability. Accordingly, in the 1954 act, by extensive relaxation of the earlier legislative prohibitions, the Congress sought to make it possible for the full talents and resources of the nation to apply themselves energetically and unremittingly to the problems of atomic energy. This does not contemplate merely a greater measure of participation in atomic energy development on the part of the power systems which some day hope to generate, transmit, distribute, and sell the nuclear power. It also contemplates participation by the equipment manufacturers, the chemical companies, the metal fabricators, the processors of all kinds of specially adapted materials, the manufacturers of instruments and controls, and the many other groups whose contributions are needed for the development of the art.

Basically, the problem is not, and has not been, to determine whether nuclear power can actually be produced. We know that it can, and we have known this for probably at least a decade. The real problem is to discover the ways by which nuclear power can be produced on an economic basis, genuinely competitively with the cost of power from conventional sources. For the regions where conventional power comes at high cost, such a competitive basis may now seem to be on the horizon;[3] but for the regions where conventional power comes at medium or low

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[1] 68 STAT. 921, 42 U.S.C.A. §§2011-2281 (Supp. 1954).

[2] 60 STAT. 755, 42 U.S.C. §§1801-19 (1946).

[3] Elsewhere in this symposium, the economic factors are considered in greater detail. See Leppke,

cost, the struggle to achieve the necessary cost reductions has hardly begun. The rapidity with which this can be accomplished will be a measure of the act's success in carrying out its declared purpose, in section 3(a), of "conducting, assisting, and fostering research and development in order to encourage maximum scientific and industrial progress."[4]

The 1954 act was intended to encourage and facilitate the widespread dissemination of the abundant technical information and know-how which, though previously narrowly confined, must be made more generally available if our atomic progress is to flourish. Likewise, it was intended to enable private enterprise (including public-power groups) to develop, invest in, and own facilities—and the components of facilities—which will produce nuclear power and special nuclear material. And in many ways, the new act specifically addresses itself to these problems of transition, at least so far as such problems could readily be foreseen. The Congress certainly hoped that the legislation would create conditions under which, as the state of the art permitted, changes could be effected promptly, taking full advantage of technological advances and the teachings of experience. At the same time, numerous statutory safeguards were adopted in order to maintain what the Congress felt was a proper balance between private interests and the public interest.

This paper will discuss some of the patent aspects of the Atomic Energy Act of 1954. Patents may appear to be a subject of rather narrow scope, but they are here referred to in their broader sense—their relation to the advancement of technology, their significance for the development of atomic power, their effects upon the practices and habits of industry, the special problems encountered in a transitional period, and the nature of the balancing safeguards included in the act.

Patent laws, it must be remembered, are not ends in themselves, but rather the means by which society seeks to attain objectives of high importance. As Chief Justice Marshall said in one of the Supreme Court's very early patent opinions, "To promote the progress of useful arts is the interest and policy of every enlightened government."[5] Traditionally, and virtually since the birth of the Republic, the United States has looked to the patent system to provide a stimulus to our scientific and industrial progress. It is in no sense the only stimulus, but it is a powerful one.

The significant benefits of the patent system may be summarized very simply: A patent confers a temporary legal monopoly. The promise of this temporary patent monopoly creates a prospect of pecuniary reward. It fosters inventive effort on the part of both the small inventor and the large company. In many instances, it supplies justification for the huge outlays of private capital required to support the

The Facts of Atomic Power Development, supra, 3-13; Tybout, *The Public Investment in Atomic Power Development, supra*, 60-90. In addition, for a summary of some of the best evidence and opinion now available, consult the papers delivered at the International Conference for the Peaceful Uses of Atomic Energy, held in Geneva, Switzerland, August 1955, particularly, *Economics of Nuclear Power*, by James A. Lane, of Oak Ridge National Laboratory, and *Capital Investment Required for Nuclear Energy*, by W. Kenneth Davis, Director of the AEC's Division of Reactor Development.

[4] 68 STAT. 922, 42 U.S.C.A. §2013(a) (Supp. 1954).

[5] Grant v. Raymond, 10 U.S. (6 Pet.) 218, 241 (1832).

intensive research and development effort which must so often precede the moment of invention or discovery. And, at the same time, this temporary legal monopoly provides an inducement for the inventor to make a public disclosure of his technical achievements which, when thus disclosed through publication of the patent, become available to the country as a whole as a base for further technological advancement. The public interest thus benefits both from the stimulation of inventive effort and from the public disclosure.[6]

The patent system, to be sure, is not without its pitfalls and its abuses. But since the very first Patent Act of 1790, it has been our consistent judgment that the wise and prudent national policy is to strengthen and conserve the patent system. We have sought to remedy the abusive practices not by destroying or undermining the patent system as a whole, but by fashioning specific measures adequate to cope with the abuses.[7]

These broad considerations are all well known. They are mentioned here, however, in order to be sure that the discussion of the special patent aspects of the atom does not become too distantly separated from its more general setting.

The Atomic Energy Act of 1954 is a statute of unusual length. It occupies forty-two closely printed pages, and, thus, is considerably longer than the United States Constitution as originally adopted. About six of the act's pages deal directly and extensively with various aspects of patents and inventions. Instead of undertaking to cover every one of these patent and invention provisions,[8] this discussion rather will concentrate on certain of their aspects that are of particular interest at the present time—namely, the incentives provided by patents and awards in the field of atomic energy; compulsory licensing; the special reporting requirements for atomic energy inventions; and the troublesome, and perhaps largely unanticipated, patent difficulties which the law creates in connection with contracts, subcontracts, arrangements, and "other relationships" with the Commission.

In considering all such matters, it is well to bear in mind the overriding importance of attaining in this country a maximum level of invention and technological

[6] To quote once again from Chief Justice Marshall's opinion in Grant v. Raymond, *supra*, the patent "is the reward stipulated for the advantages derived by the public for the exertions of the individual, and is intended as a stimulus to those exertions." 10 U.S. (6 Pet.) at 241-42.

[7] For example, the antitrust litigation of the past few decades has unearthed a variety of abusive patent practices which have met with vigorous corrective action by the federal courts. *E.g.*, Hartford-Empire Co. v. United States, 323 U.S. 386 (1945); United States v. United States Gypsum Co., 333 U.S. 364 (1948); United States v. New Wrinkle, 342 U.S. 371 (1952). The Atomic Energy Act of 1954 contains affirmative provisions designed to reduce the opportunities for antitrust violations to occur in the atomic energy field. See particularly the general provisions in §105, 68 STAT. 938, 42 U.S.C.A. §2135 (Supp. 1954); and the further provision in §158, 68 STAT. 947, 42 U.S.C.A. §2188 (Supp. 1954), to the effect that if any patent in the atomic energy field is found by a court to have been intentionally used in a manner so as to violate the antitrust laws, then the court may require the patent to be subject to compulsory licensing on a reasonable royalty basis, and this is "in addition to any other lawful sanctions."

[8] In an article entitled *Patents Under the New Atomic Energy Act*, 36 J. PAT. OFF. SOC'Y 867 (1954), I have attempted to discuss, at least briefly, each of the act's provisions relating to patents and inventions. See also the illuminating address by Casper W. Ooms, *Revisions of the Patent Provisions—Good or Bad?*, NATIONAL INDUSTRIAL CONFERENCE BOARD, CONFERENCE ON ATOMIC ENERGY IN INDUSTRY 279 (1954).

advancement throughout the field of atomic energy. We live in a world intensely competitive. On both the national defense and the peaceful sides of the atom, the necessity of maintaining our position of leadership is generally understood. Perhaps after the International Conference for the Peaceful Uses of Atomic Energy, held in Geneva, Switzerland, in August 1955, this has become understood even more clearly than it was before.

Great as our atomic energy progress has been since 1942, we know vaguely that we are yet only on the threshold of discovery. There is still truth today in what John Stuart Mill wrote more than a hundred years ago:[9]

> Our knowledge of the properties and laws of physical objects shows no sign of approaching its ultimate boundaries; it is advancing more rapidly, and in a greater number of directions at once, than in any previous age or generation, and affording such frequent glimpses of unexplored fields beyond, as to justify the belief that our acquaintance with nature is still almost in its infancy.

How well, therefore, are the patent provisions of the 1954 Atomic Energy Act adapted to speeding us forward into these "unexplored fields beyond"?

THE SYSTEM OF PATENT AND AWARD INCENTIVES

To understand what the 1954 act accomplishes by way of patent incentives, it is necessary to consider the situation which the 1946 act created and then to reflect upon how that has been modified.[10]

A basic feature of the 1946 act was that it removed from the regular patent system two important areas—first, atomic weapons, and second, the production of fissionable material. The reasoning underlying this was clear and simple. The two areas were, under the 1946 act, areas of government monopoly; accordingly, in these areas, the private monopoly of a patent could have no scope for normal operation and hence would have little meaning. What the 1946 act provided was that an invention, to the extent it was useful in either of these areas, should be excluded from the regular patent system. The inventor was, to that extent, disabled from obtaining a patent monopoly on it. But the act did not lose sight of the importance of providing some substitute pecuniary incentive and reward in these areas. This was supplied by affording to the inventor—in lieu of the right to obtain a patent—a right to apply for and obtain a statutory award from the Commission in a formal proceeding conducted before the AEC Patent Compensation Board. The amount of the award was left to the Board to determine in the light of certain valuation standards set forth in the act.[11]

[9] JOHN STUART MILL, PRINCIPLES OF POLITICAL ECONOMY Bk. 4, c. 1, §2, at 422 (People's ed. 1880).

[10] For more extensive discussion of patent developments under the original Atomic Energy Act, see Ooms, *The Patent Provisions of the Atomic Energy Act*, 15 U. CHI. L. REV. 822 (1948); Boskey, *Inventions and the Atom*, 50 COLUM. L. REV. 433, and 32 J. PAT. OFF. SOC'Y 563 (1950); Boskey, *Operation of the Patent Provisions of the Atomic Energy Act*, 32 J. PAT. OFF. SOC'Y 808 (1950); Ooms, *Problems of Patent Policy for Government and Industry in Atomic Energy*, in ATOMIC ENERGY INDUSTRIAL AND LEGAL PROBLEMS 155 (1952).

[11] The work of the AEC Patent Compensation Board under the 1946 act is considered at some length

In the new act of 1954, the entire field of atomic energy development is restored to the patent system, except for the area of atomic weapons which remains very much as before. Atomic weapons production has, for obvious reasons, been kept a government monopoly, and, as a corollary, the atomic weapons area has been left outside the regular patent system. Thus, an invention still cannot be the subject of patent rights to the extent that the invention is useful "in the utilization of special nuclear material or atomic energy" in atomic weapons; this is the consequence of the terms of section 151 of the act.[12] In such a case, the inventor has the same right which he had previously—that is, to apply to the AEC Patent Compensation Board for a suitable award.[13]

In view of the government monopoly over atomic weapons production, however, a patent itself would hardly do any more for the inventor, other than to confer the rather doubtful privilege of being able to proceed in the first instance in the Court of Claims[14] instead of before the AEC Patent Compensation Board, whose decisions are subject to judicial review.[15] Indeed, though generalization may be risky, there seems to be good ground for taking the view that an inventor who has made a real contribution in the atomic weapons area is likely to fare better in an award proceeding before the AEC Patent Compensation Board than he would in a suit in the Court of Claims.[16] Under all the circumstances, therefore, it is hard to believe that the exclusion of the atomic weapons area from the regular patent system actually has any negative effect on technical progress, or that any greater stimulation of invention would be provided if patent rights were allowed to extend into this area.

There are, of course, problems of interpretation which this portion of the act brings with it—for example, questions as to the exact limit of the definition of

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in the articles cited in note 10, *supra*. Under the 1954 act, the principles applicable to proceedings before the Board will continue to be largely along lines begun under the 1946 act, but it may now be necessary for the Board to function on a much more extensive scale. A significant rise in the volume of cases brought to the Board is likely to result from the great increase in the amount of independent work which will now be carried on in the atomic energy field. Moreover, as will appear below, the Board's statutory jurisdiction to grant awards has been substantially broadened by the 1954 act. In addition, by virtue of §173 of the act, 68 STAT. 953, 42 U.S.C.A. §2223 (Supp. 1954), and of the recently promulgated §80.10(d) of the Commission's regulations, 20 FED. REG. 3931 (1955), the Board now has jurisdiction to determine the just compensation to be paid in the event that restricted data contained in a privately owned patent application is communicated by the AEC to some foreign nation. See also, AEC EIGHTEENTH SEMIANNUAL REP. 100 (1955). It is important to note that the procedural changes which the Commission has made in its regulations subsequent to the new act, 20 FED. REG. 3931 (1955), do not modify the basic provision, §80.60(c), of the regulations adopted by the Commission under the 1946 act to the effect that "the order of the Board shall constitute the final action of the Commission."

[12] 68 STAT. 943, 42 U.S.C.A. §2181 (Supp. 1954).

[13] See §157, 68 STAT. 947, 42 U.S.C.A. §2187 (Supp. 1954).

[14] Pursuant to 28 U.S.C. §1498 (Supp. 1952).

[15] See §189, 68 STAT. 955, 42 U.S.C.A. §2239 (Supp. 1954).

[16] One of the reasons for this is that the Board is more likely to be able to grapple successfully with the problem of secrecy—which may be particularly acute in the atomic weapons area—and to give proper evaluation to the contribution which the inventor has made. See Boskey, *Inventions and the Atom*, 50 COLUM. L. REV. 433, 440-46, and 32 J. PAT. OFF. SOC'Y 563, 572-81 (1950).

"atomic weapon" which appears in section 11(d).[17] But such peripheral problems do not appear to be of large dimension, nor do they create major uncertainties which would impair the effectiveness of the act.

Thus, in the atomic weapons area, the patent situation remains essentially as before. Perhaps one further point should be noted, since it is of particular interest in connection with atomic power development. An invention may have a double usefulness; it may be useful in the atomic weapons area and useful likewise, for example, in the production of special nuclear material. The act makes it clear that the exclusion of such an invention from the patent system is an exclusion which operates only to the extent the invention is useful in the atomic weapons area. With respect to its other uses, this same invention may be the subject of a patent to which normal patent rights attach. This is the result of the basic change of approach which the 1954 act embodies. For, in the 1954 act, as a concomitant of the changes which now make it possible for private enterprises to own their own reactors and other facilities for the production of fissionable material, the whole area of inventions useful in the production of fissionable material is restored to the patent system. Moreover—although this was sometimes overlooked—the area of inventions useful in the production of nuclear power had never been taken out of the patent system, even by the 1946 act.[18] Consequently, the entire field of atomic power development is now, for all practical purposes, firmly within the patent system which operates in other industrial fields.

This must, however, be understood to be subject to certain special conditions which the Atomic Energy Act makes applicable to inventions in the field of atomic energy alone. The most important of these special conditions arise from the provisions on compulsory licensing, on reporting requirements, and on commission relationships—all to be discussed below. Before proceeding to that discussion, however, an additional word should be said concerning an extra incentive which the 1954 act provides in the form of a right to an award.

Under the 1946 act, the right to an award was established only as a substitute for patent rights. But in the new act, while the right to a patent has, as we have seen, been broadened considerably, nevertheless, the right to an award has not been correspondingly narrowed; instead, it too has been broadened. This becomes ap-

[17] 68 STAT. 922, 42 U.S.C.A. §2014(d) (Supp. 1954). Note, however, that the definition of "atomic weapon" in §11(d), when read in conjunction with the definition of "atomic energy" in §11(c), 68 STAT. 922, 42 U.S.C.A. §2014(c) (Supp. 1954), establishes that "atomic weapon" is meant to include fusion weapons as well as fission weapons—that is, H-bombs as well as A-bombs. The language of the act makes this clear, as does the legislative report of the Joint Committee on Atomic Energy, which states, "This definition [of 'atomic energy'] includes both fission and fusion types of nuclear reactions." H.R. REP. No. 2181, 83d Cong., 2d Sess. 11 (1954).

[18] This was with the possible exception of inventions used simultaneously (as, for example, in a dual-purpose reactor) to produce both nuclear power and fissionable material. See Boskey, *The Atomic Energy Act and the Power Question*, Nucleonics, Oct. 1952, pp. 10, 13; and also testimony before the Joint Committee on Atomic Energy on May 11, 1954, in *Hearings before the Joint Committee on Atomic Energy on S. 3323 and H.R. 8862, To Amend the Atomic Energy Act of 1946*, 83d Cong., 2d Sess., pt. 1, at 129 (1954). The term "fissionable material," which was used in the 1946 act, has been superseded by "special nuclear material" in the 1954 act.

parent from section 157(b)(3), which provides in substance that any person "making any invention or discovery useful in the production or utilization of special nuclear material or atomic energy" may apply to the AEC for an award and that the AEC may grant an award.[19] Thus, the right to apply for an award is by no means confined to the atomic weapons area, which is the only area now excluded from the patent system. By a deliberate decision of the Congress, the award system has been extended throughout virtually the entire atomic energy field. It is a stimulus which the 1954 act has provided in addition to, rather than merely in lieu of, the right to obtain a patent, and it affords the inventor an opportunity both for recognition and for pecuniary reward which is supplemental to his rights under the patent system.[20]

Particularly to the small inventor who is able and willing to perform independent work in the field of atomic power development, this additional stimulus may be a matter of especial importance. The field is one where the serious prosecution of a patent application, at least in the case of a somewhat complex invention, may become highly expensive and burdensome. Moreover, the hazards and uncertainties of the ultimate outcome in the Patent Office are greatly increased because of the vast amount of prior art that has been kept from public disclosure by virtue of Patent Office secrecy orders often extending over a period of many years.[21] Accordingly, whereas the prospect of trying to prosecute a patent application may, in some cases, seem rather bleak and uninviting, in those same cases, the possibility of obtaining a statutory award under section 157(b)(3) of the act may provide a genuine incentive.[22]

[19] 68 STAT. 947, 42 U.S.C.A. §2187(b)(3) (Supp. 1954).

[20] In connection with the use of awards as a supplemental stimulus to invention, it should be noted that on July 30, 1955, the House of Representatives passed H.R. 2383 (to be called the Inventive Contributions Awards Act), 101 CONG. REC. 10602 (daily ed. July 30, 1955), which would authorize the National Inventors Council within the Department of Commerce to make awards for meritorious inventive contributions to the national defense, when such inventive contributions have been communicated to and used by a "defense agency" (exclusive of the AEC). If such legislation is enacted, it would furnish a basis for statutory awards in fields other than atomic energy; and, like the awards (except in the atomic weapons area) under §157(b)(3) of the Atomic Energy Act of 1954, such awards would be supplemental to, rather than in lieu of, patent rights. The purpose of the bill is to foster invention for national defense and to remedy the very unsatisfactory situation which presently exists because of the fact that the sole recourse of the inventor is generally in the Court of Claims. See *Hearings before Subcommittee No. 3 of the House Committee on the Judiciary on H.R. 639 and H.R. 2383, Inventive Contributions Awards Board*, 84th Cong., 2d Sess. (1955); and also H.R. REP. No. 1432, 84th Cong., 1st Sess. (1955). The bill is now pending before the Senate Committee on the Judiciary.

[21] Presumably, these secrecy orders will begin to be lifted more rapidly as a result of the Commission's recent enlargements of the areas of information being declassified. But even in such cases, it is to be anticipated that there will often be a substantial time lag between the declassification of certain technological information and the actual lifting of the Patent Office's secrecy order on the corresponding patent application.

[22] In addition to this statutory right to apply for an award, which is established by the first sentence of §157(b)(3), the second sentence of §157(b)(3) goes on to provide that: "The Commission may also, upon the recommendation of the General Advisory Committee, and with the approval of the President, grant an award for any especially meritorious contribution to the development, use, or control of atomic energy." This latter provision was first used to make an award of $25,000 to Enrico Fermi, shortly before his death, and the Commission has announced that future awards of this category will be known as the Fermi Prize. See AEC SEVENTEENTH SEMIANNUAL REP. 38-40 (1955). It should be noted that under the terms of the act, such an award need not necessarily be based on an "invention or discovery," but may be conferred for some other type of "especially meritorious contribution" as well.

COMPULSORY LICENSING

The subject of compulsory licensing is highly controversial and often misunderstood. One viewpoint considers that patents in all fields of industrial activity should be subject to some type of compulsory licensing requirements, as they are in certain countries abroad. Another viewpoint considers that any form of compulsory licensing authority—even when confined to the field of atomic energy, and there on a very limited basis—represents a vicious and, indeed, unconstitutional inroad upon the patent system. Perhaps most people take a somewhat middle view, and, in any event, that is what the Congress has done in the 1954 Atomic Energy Act.

In the 1946 act, section 11(c), enacted after much heated debate, had given the AEC fairly broad authority—and, indeed, had placed the AEC under a duty—to declare a patent to be affected with the public interest if both of two conditions were met: (1) that the invention "utilizes or is essential in the utilization of fissionable material or atomic energy," and (2) that compulsory licensing was "necessary to effectuate the policies and purposes of this Act."[23] The consequences of thus declaring a patent affected with the public interest would have been twofold. First, the AEC itself would then have been licensed to use the invention on a reasonable royalty basis—a somewhat superfluous grant of authority in view of the general right which the Government possesses to use all patented inventions and to remit the patent owner to his remedy for compensation in the Court of Claims.[24] Second, and more important, a license to use the invention on a reasonable royalty basis would also have been conferred automatically upon anyone who held a section 7 (of the 1946 act) license relating to utilization of atomic energy.[25]

No section 7 license relating to utilization of atomic energy was ever issued by the AEC under the 1946 act, because the provisions of section 7 did not come into operation. Accordingly, the occasion for declaring any particular patent to be affected with the public interest did not really ever arise, nor was it ever necessary that the possibility of doing so in a particular case be given serious consideration. The AEC, at a fairly early date, and partly in the hope of allaying some of the public misunderstanding concerning this portion of the act, took pains to describe the compulsory licensing authority as a "reserve power" to be used "under certain rather exceptional circumstances."[26] Thus the matter rested, with the controversy slumbering but not stilled, at the time the act came up for general revision.

In the hearings on the new act, various shades of opinion concerning the compulsory licensing provisions were given full expression before the Joint Committee on Atomic Energy.[27] The view that prevailed in the Congress was that, during

[23] 60 STAT. 768, 42 U.S.C. §1811(c) (1946).
[24] See 28 U.S.C. §1498 (Supp. 1952).
[25] 60 STAT. 764, 42 U.S.C. §1807 (1946).
[26] See AEC FIFTH SEMIANNUAL REP. 148 (1948).
[27] Varying views on this aspect of the patent provisions had been expressed by witnesses testifying before the Joint Committee on Atomic Energy during the course of the preliminary hearings, entitled *Atomic Power Development and Private Enterprise*, held in June and July 1953 (83d Cong., 1st Sess.). President Eisenhower's message of February 17, 1954, recommending revision in the atomic energy

this period of transition, for special reasons which would not apply in other fields of industry, it would be advisable to retain a very limited form of compulsory licensing authority in the field of atomic energy. Although voted down by the House, this was insisted upon by the Senate and became a part of the final enactment.[28]

The basic purpose of the limited compulsory licensing authority which thus remains in the law is to provide, during the transitional period, a safeguard which will help to assure the widest practicable participation in the atomic energy program. As such a safeguard, it may partially offset the initial inequality of opportunity resulting from the AEC monopoly which existed under the 1946 act but which should largely disappear during the years to come. The power is one which the Commission may never be called upon to exercise; yet, its mere presence in the law is a safety valve which may prevent abusive or unhealthy conditions from being created as this industry emerges from the cocoon of secrecy and government monopoly.

Examination of the detailed compulsory licensing provisions of the 1954 act will show how very strictly the Congress has confined the Commission's authority in this respect, and, hence, how groundless are the fears that some vital inroad has been made upon the patent system. The rather general authority which the Commission possessed under the 1946 act has been considerably narrowed. Under the new act, it is not nearly enough, as it was before, that the invention is found to come within a broadly defined atomic energy field and that the AEC should determine compulsory licensing to be necessary to effectuate the policies and purposes of the act. Instead, section 153(a) now requires that, before declaring a patent to be affected with the public interest, the Commission must find that the invention "is of primary importance in the production or utilization of special nuclear material or atomic energy"; and before such determination is made, the act directs the Commission to give the patent owner an opportunity for hearing.[29] Furthermore, section 153(b)(2) requires that, even after such determination has been made, a compulsory license on a reasonable royalty basis shall be issued to a particular applicant only if the Commission finds his proposed use "is of primary importance to the conduct of an activity by such person authorized under this act."[30] It is not wholly clear

legislation, included a recommendation that some form of compulsory licensing authorization be retained for a limited period because "considerations of fairness require some mechanism to assure that the limited number of companies, which as Government contractors now have access to the program, cannot build a patent monopoly which would exclude others desiring to enter the field." H.R. Doc. No. 328, 83d Cong., 2d Sess. 7 (1955). Considerable testimony on the subject of compulsory licensing, covering a wide range of views, was again received by the Joint Committee in the public hearings which immediately preceded the enactment of the law. See *Hearings, supra* note 18.

[28] See especially the Statement of the Managers on the Part of the House, in the second conference report, H.R. REP. No. 2666, 83d Cong., 2d Sess. (1954), appearing at 100 CONG. REC. 14867 (1954), and the accompanying legislative debate. The legislative history is set forth in greater detail in note 44 *infra*.

[29] 68 STAT. 945, 42 U.S.C.A. §2183(a) (Supp. 1954).

[30] 68 STAT. 945, 42 U.S.C.A. §2183(b)(2) (Supp. 1954).

from the act itself whether the patent owner is entitled to a hearing on the issues raised by the particular application, but it appears that the AEC does intend, by its regulations, to assure to the patent owner this important procedural safeguard.[31]

Here then, in consequence of the terms of section 153(a) and 153(b), is a new double-barreled, "primary importance" test which places significant statutory limitations on the scope of the Commission's authority. While the meaning of the phrase "primary importance" may not be entirely self-evident and may require elucidation from records developed before the Commission in particular cases if they should ever arise, the act itself plainly was intended to lay down a basic principle that the compulsory licensing power cannot be exercised merely as a matter of routine or to carry out some relatively inconsequential purpose.

In addition, section 153 provides an alternative procedure whereby compulsory licensing proceedings may be initiated by an outsider who wants to obtain such a license, rather than by the AEC itself. For such a case, there are detailed procedural provisions which assure the patent owner the protection of a full hearing. Moreover, here the Commission's authority is once again hedged in by the "primary importance" test, but this time on a triple-barreled basis. Not only must the Commission find that the invention is of "primary importance" in the field and that obtaining the compulsory license is of "primary importance" to the applicant; the Commission is also required to find that the applicant's proposed activities are of "primary importance" to the furtherance of policies and purposes of the act. In addition, the Commission must find that the applicant cannot otherwise obtain a patent license from the patent owner on terms which the Commission deems reasonable. Then, and only then, may the AEC issue a compulsory license under this alternative procedure.[32]

It will, thus, be seen that, under either of the procedures set forth in the statute, the Congress has surrounded the compulsory licensing power by a series of restrictive conditions which would make it virtually impossible for that power to be exercised except in a comparatively rare and factually compelling case. Indeed, this would be true even if the Commission itself were not predisposed—as it so clearly is by its belief in the importance of the patent system—to regard compulsory licensing as a "reserve power."[33] The power could be exercised, if necessary in some exceptional case, to prevent the progress of the entire industry from being blocked by an unduly

[31] This was not evident either from the proposed regulations on Standard Specifications for the Granting of Patent Licenses, which the AEC issued on April 7, 1955, 20 FED. REG. 2283 (1955), or from the proposed regulations on Rules of Practice, which the AEC issued on August 10, 1955. *Id.* at 5786. But there have been informal indications that, when the full set of AEC regulations is issued in final form, this safeguard will be expressly provided for.

[32] 68 STAT. 945, 42 U.S.C.A. §2183(c), (d), (e) (Supp. 1954).

[33] See, for example, the Commission's statement in *Hearings, supra* note 18, pt. 2, at 597. In testifying before the Joint Committee on February 4, 1955, in *Hearings before the Joint Committee on Atomic Energy on Development, Growth, and State of the Atomic Energy Industry*, 84th Cong., 2d Sess. pt. 1, at 194 (1955), William Mitchell, the AEC General Counsel, stated: "The compulsory licensing provisions of §153 of the act are deemed by the Commission to establish a reserve power. It is not anticipated that this authority will be invoked, except under compelling circumstances."

wide monopoly over a vital invention. Only the future can tell us whether any such situation will ever arise with respect to the inventions or discoveries which come into existence before September 1, 1959.[34]

REPORTING REQUIREMENTS

The 1946 act contained a 60-day reporting requirement for inventions in those areas of atomic energy which the act excluded from the regular patent system.[35] By section 151(c) of the 1954 act, the 60-day period has been increased to 90 days,[36] and this undoubtedy makes compliance considerably more practicable. But more important, section 151(c) has substantially enlarged the areas of invention that are covered by the reporting requirement.

In its present form, the reporting requirement is not limited to the atomic weapons area, which, as we have noted, is the only area now excluded from the patent system. The requirement reaches out to include also all inventions or discoveries useful either in the "production" or in the "utilization" of either "special nuclear material or atomic energy." The purpose of this provision was described in the Joint Committee's legislative report as being "to keep the Commission fully and currently aware of all technology in the field of atomic energy."[37] In other words, no one is authorized to hold back from the Commission any new technological development which might be important in the planning or execution of the Commission's programs and other responsibilities. And what the act calls for in the report is "a complete description" of the invention or discovery.

It will be noted that the terms employed in the reporting provision have an extensive coverage, which would facilitate their being interpreted so as to accomplish their exceptionally broad purpose. Since most inventions in the field of atomic power development either will clearly fall within the scope of this reporting provision, or arguably might do so, it is worth considering, for a moment, what the effects of this important part of the act may be.

[34] By §153(h) of the act, 68 STAT. 945, 42 U.S.C.A. §2183(h) (Supp. 1954), the compulsory licensing provisions apply to any patent the application for which shall have been filed before September 1, 1959—in other words, inventions conceived during a period of approximately five years from the enactment of the 1954 act. The Senate had voted to make this period ten years, on the ground that five years would not provide a sufficiently long interim period (see 100 CONG. REC. 12002-03 (1954)), but, on this point, yielded to the House. It should be noted, however, that under the act, the compulsory licensing provisions are applicable to such inventions during the entire seventeen-year life of the patent after the patent has been issued. Indeed, were it otherwise, the compulsory licensing provisions would be virtually meaningless: for one thing, the licensee then would have no assurance of being able to retain the license after the five-year period expired and hence he would hardly be justified in investing any capital on the strength of such a license; for another, the time lag in the Patent Office for prosecution of patent applications means that probably not a great many of the privately owned patents in the field should be expected to issue much before September 1, 1959, and, accordingly, the need for the compulsory licensing safeguard, with respect to such inventions, would be most likely to arise after September 1, 1959.

[35] See §11(a)(3), 60 STAT. 768, 42 U.S.C. §1811(a)(3) (1946).

[36] 68 STAT. 943, 42 U.S.C.A. §2118(c) (Supp. 1954).

[37] H.R. REP. No. 2181, 83d Cong., 2d Sess. 25 (1954). The Commission itself described the purpose of the provision as follows: "By being fully apprised of private invention in this field, the Commission will be in a position to allocate its resources and funds where they are most needed. Without knowledge of private achievement avoidance of duplication of effort cannot be assured." See *Hearings, supra* note 18, at 598.

First, it should be made clear that section 151(c) gives to the inventor an election. Within the 90-day period, either he must file a patent application in the Patent Office or else he must file an invention report with the AEC, but he is not required to do both. Different considerations may influence his choice in particular cases, but if he is not prepared to undertake the expense and the trouble of filing a patent application, then he is under an affirmative duty to report the invention to the AEC. If he does elect to file a patent application, the invention, in due course, will presumably be made known to the AEC by the Commissioner of Patents, in view of section 151(d) of the act, which requires the Commissioner of Patents to notify the AEC and provide the AEC with access to all patent applications which, in the Commssioner's opinion, disclose inventions within the categories listed in the reporting requirements of section 151(c).[38]

Next, there is the question of computation of the 90-day reporting period. The act fixes the time as on or before the ninetieth day after whichever of two events is later—either the ninetieth day after "completion of such invention," or the ninetieth day after the inventor "first discovers or first has reason to believe" that the invention is useful in such production or utilization. This language is not substantially different from that in the 1946 act, but it raises a number of practical problems as to interpretation. For example, the meaning of the word "completion" is not fully self-explanatory and will have to be considered carefully in the light of all the circumstances of the particular case. Questions of this type have not yet come up for administrative or judicial decision under either the 1946 or the 1954 act. Until they do, the cautious approach will be to err on the side of filing the report or the patent application too soon rather than too late.

It is perfectly natural for a company or an individual working in this field to wonder what might be the consequences of not complying with the reporting requirements of section 151(c). As a matter of principle, of course, most people will want to be sure they are taking adequate steps for compliance, regardless of whether noncompliance might bring with it any serious legal consequences. Moreover, apart from legal consequences, there are the obvious problems as to good reputation and public relations, both of which could be adversely affected by noncompliance.

But the matter does not stop there. There are, in fact, some important legal consequences that need to be considered. One is expressly spelled out in the act, in connection with the statutory awards for inventions in the atomic energy field. Section 157(b)(3), dealing with eligibility for such awards, makes it a condition of eligibility that the applicant shall have complied with the provisions of section 151(c). Hence, an invention which has not been either filed in the Patent Office or reported to the AEC within the stipulated 90-day period could not be the subject of a statutory award. The AEC Patent Compensation Board has so held in a recent decision, stating that the reporting requirement is "a requirement which this Board may not waive or overlook."[38a]

[38] 68 STAT. 943, 42 U.S.C.A. §2183(d) (Supp. 1954).

[38a] See *In re* Grossman, Docket No. 17 (Oct. 25, 1955), reported in ATOMIC INDUSTRY REP. 235:641,

Another rather serious legal consequence might arise in connection with activities carried on pursuant to license or permit issued by the AEC. For example, the Commission's regulations provide that access permits, or facilities licenses, or licenses for distribution of special nuclear material shall all be subject to suspension or termination by the AEC for violation of or failure to observe any of the terms of the Atomic Energy Act of 1954 or Commission regulations.[39] Accordingly, failure to comply with the reporting requirements of section 151(c)—particularly if such failure were to be continuous and deliberate—could place in jeopardy an access permit or a license which the AEC has issued.

There is also the possibility that the validity of a patent eventually issued to cover the particular invention might be drawn in question if noncompliance with these reporting requirements could be established. This is a point which has not yet been litigated in patent suits involving the interpretation of either the 1946 or the 1954 Atomic Energy Act. Perhaps it will not be litigated for some time to come. But in the absence of a definitive adjudication, it would be hard to say with assurance that an inventor who fails to live up to the reporting requirements of section 151(c) may not also have thrown away his patent rights.

In addition, there is even the possibility that noncompliance with the reporting requirements of section 151(c) might be punishable criminally, if the Government were to establish beyond a reasonable doubt that the violation had been willful.[40]

Section 151(c) does not distinguish between inventions of great significance and inventions of small significance; it applies to every "invention or discovery" in the atomic energy field defined. Hence, the reporting requirements cannot safely be ignored merely on the ground that the invention does not measure up to whatever level of importance the company normally looks for when deciding to file and prosecute a patent application. Nor can information be withheld merely on the ground that it constitutes know-how or trade secrets which normally would be tightly held within the company; if such know-how or trade secrets embody an "invention or discovery" within the atomic energy field defined, then the invention or discovery is

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235:643 (1955). The case on its facts involved the applicant's failure to comply with the reporting requirements of the 1946 act, but on this point, it is clear that there would have been no difference if the 1954 act had been involved.

[39] See the proposed regulations concerning Access to Restricted Data, §25.15, 20 FED. REG. 3635 (1955); Licensing of Production and Utilization Facilities, §50.100, *id.* at 2491; and Special Nuclear Material, §70.61(b), *id.* at 2494. It is to be expected that such provisions will be continued when the respective regulations are issued in final form.

[40] Section 223 of the 1954 act provides: "Whoever willfully violates, attempts to violate, or conspires to violate, any provision of this Act for which no penalty is specifically provided . . . shall, upon conviction thereof, be punished by a fine of not more than $5,000 or by imprisonment for not more than two years, or both. . . ." 68 STAT. 958, 42 U.S.C.A. §2273 (Supp. 1954). If this criminal penalty should be determined to be applicable to noncompliance with the reporting requirements of §151(c), then it would be important to consider in this connection the possible meanings and scope of the word "willfully," as here used. *Cf.* United States v. Murdock, 290 U.S. 389 (1933); Browder v. United States, 312 U.S. 335, 341-42 (1941); Spies v. United States, 317 U.S. 492 (1943); Screws v. United States, 325 U.S. 91, 101-07, 151-57 (1945).

plainly subject to the reporting requirements.[41] Moreover, the fact that the invention may be developed during the course of a contract with the Army, the Navy, the Air Force, or some other federal agency besides the AEC, and, hence, may be subject to a separate reporting requirement of the government agency which has let the contract, would not appear to justify or excuse noncompliance with section 151(c). In addition, nothing in the act appears to confer upon the Commission itself an authority to grant extension of time, and hence it is doubtful whether the Commission would be authorized to grant, by contract or otherwise, a period longer than the specified 90 days, even to its own contractors.[42]

All these considerations give to the reporting requirements a practical operating importance which, at first glance, might easily be overlooked. There is probably nothing about the reporting requirements which a well-managed business cannot live with in peace and harmony. But to do so requires careful planning and review, as well as a genuine desire to comply.

CONTRACTS AND OTHER RELATIONSHIPS WITH THE AEC

Section 152 of the 1954 act has a title, "Inventions Conceived During Commission Contracts," which hardly suggests the mischievous and vexatious nature of its contents.[43] In the Congress, the legislative process does not always move with complete smoothness and efficiency—particularly toward the end of a long and controversial session. Section 152 evidences some of the weaknesses inherent in the legislative process, just as certain other portions of the act stand as monuments to its strength.

What Section 152 does by its terms is to vest in the Government, rather than in the inventor, the ownership of atomic energy inventions conceived under contracts, subcontracts, arrangements, or "other relationships" with the Commission, except to the extent that the Commission may waive such rights of the Government. That this is an unintentionally far-reaching and troublesome provision has now become apparent.

Perhaps the most important contributing factor to the section 152 difficulties was the fact that neither its provisions nor anything like them were in the bill at the time of the main public hearings held by the Joint Committee on Atomic Energy.

[41] It may well be, however, that if appropriate justification is furnished, the Commission will be prepared to maintain the confidentiality of trade secrets. *Cf.* §2.790 of the proposed AEC Rules of Practice, relating to requests for withholding documents from public inspection. 20 FED. REG. 5792 (1955).

[42] Section 161(q) of the 1954 act, 68 STAT. 948, 42 U.S.C.A. §2201(q) (Supp. 1954), confers on the Commission authority to "make, promulgate, issue, rescind, and amend such rules and regulations as may be necessary to carry out the purposes of this Act." It would not be easy to bring within that authorization a regulation which purported to relieve the inventor entirely of his obligation to make a report within the 90-day period which §151(c) specifically lays down. On the other hand, it might be within the Commission's authority to establish by regulation a system of short-form reporting, which called for filing within the 90-day period an initial short-form report that would later be amplified. A principal problem in connection with drafting any such regulation, however, would be to devise a short-form report which, nevertheless, met the statutory requirement that the report to be filed within the 90-day period should contain a "complete description" of the invention or discovery.

[43] 68 STAT. 944, 42 U.S.C.A. §2182 (Supp. 1954).

Thus, section 152 never had the benefit of the public comment and criticism which is so often indispensable in forging legislation that will be truly adequate to meet the problems of the day. What happened was that section 152 was put forward somewhat later, by those who were opposed to the compulsory licensing provisions, in the hope of persuading their colleagues in Congress that section 152 would make it unnecessary to include any compulsory licensing provisions whatsoever. The final result, however, was that instead of selecting between one or the other, the Congress included both sets of provisions in the act.[44]

After the act was passed, the detailed provisions of section 152 began to receive more intensive scrutiny. It has already become apparent that the language of section 152 is giving rise to problems of real magnitude. By its terms, the section is applicable to any invention useful in the production or utilization of special nuclear material or atomic energy if the invention is "made or conceived under any contract, subcontract, arrangement, or other relationship with the Commission, regardless of whether the contract or arrangement involved the expenditure of funds by the Commission." The section goes on to provide that in any such case, the invention "shall be deemed to have been made or conceived by the Commission"—in other words, to be government property rather than the private property of the inventor. The section then contains an exception on which very much hinges. The exception provides that the Commission "may waive its claim" to any such invention "if made or conceived by any person at or in connection with any laboratory under the jurisdiction of the Commission as provided in section 33,[45] or under such circumstances as the Commission may deem appropriate."

[44] The bills which served as the principal basis of the testimony given before the Joint Committee on Atomic Energy in the public hearings were H.R. 8862 and S. 3323, identical bills introduced on April 15, 1954, 83d Cong., 2d Sess. These bills contained neither compulsory licensing provisions nor anything resembling what later became §152. After the testimony from the public—though not from government agencies—had been virtually completed, there was prepared and circulated a committee print, dated May 21, 1954, incorporating numerous changes proposed at that time to be made in the bill. This committee print did not contain any compulsory licensing authorization, but it did contain what was a forerunner of the §152 finally incorporated in the act. This forerunner of §152 received rather critical comment from the Commission in testimony given on June 2, 1954. See *Hearings, supra* note 18, pt. 2, at 598-99. The bill as reported out by the Joint Committee on June 20, 1954 (H.R. 9757 and S. 3690) contained a limited compulsory licensing authorization but not a §152 provision. In that form, it passed the Senate as H.R. 9757, with certain amendments, on July 27, 1954. 100 CONG. REC. 12242 (1954). Meanwhile, on July 26, 1954, the bill had been passed by the House, *id.* at 12024-26, after the House, on July 23, 1954, had accepted an amendment offered by Representative Cole which substituted the present §152 for the compulsory licensing provisions. *Id.* at 11721-29. Because of these and other differences between the Senate and the House, the bill went to conference. The first conference report, dated August 6, 1954, retained the §152 provisions, but in lieu of compulsory licensing, it sought to introduce a provision directing the Commission to give preferred consideration for §103 commercial licenses, during the next five years, to those applicants who agreed to make their patents available on a reasonable royalty basis to all other commission licensees who demonstrated need therefor. See H.R. REP. No. 2639, 83d Cong., 2d Sess. 36, 48-49 (1954). This conference report was agreed to by the House, 100 CONG. REC. 13787 (1954), but was rejected by the Senate. *Id.* at 14364. A second conference report, H.R. REP. No. 2666, 83d Cong., 2d Sess. (1954), containing the provisions finally incorporated in the 1954 act, was then submitted to and accepted by both House and Senate. 100 CONG. REC. 14852-73, 14603-06 (1954).

[45] Section 33, 68 STAT. 928, 42 U.S.C.A. §2053 (Supp. 1954), covers a special situation—probably of relatively minor importance with respect to the general patent aspects of this subject—where the Com-

This statutory language furnishes virtually no standards by way of guidance. The general purpose of the sponsors of this amendment appears to have been to put the Commission in a position where the Commission would be able to prevent firms from profiting in an inappropriate manner from their association with the government-financed atomic energy program.[46] Hence, the Commission is confronted with some very understandable difficulties in determining where it is "appropriate" to relinquish these important property rights which the act otherwise vests in the Government.[47] Moreover, when the breadth of the coverage is considered—"under any contract, subcontract, arrangement or other relationship with the Commission, regardless of whether the contract or arrangement involved the expenditure of funds by the Commission"—it would be possible to conclude that very few people might be able to own a patent in the field of atomic energy, except by leave of the Commission in the exercise of its discretionary waiver authority. Since the statute expressly provides that the use of federal funds by the inventor is not required in order to bring the relationship within section 152, the terms which the Congress put into this section would appear to have a reach that goes remarkably far.[48]

An obvious question is whether the sweeping language of section 152 would vest in the Government the inventions conceived by a research licensee operating under a section 104 research license from the Commission,[49] or those conceived by a commercial licensee operating under a section 103 commercial license from the Commission.[50] If so, it might appear that section 152 has succeeded in taking back almost the very thing that the other patent provisions of the act were designed to assure. Fortunately, there is some rather direct legislative history indicating that a mere licensee was not intended to be included.[51]

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mission carries on research for others in its own facilities because private facilities are inadequate for the purpose.

[46] In introducing the amendment, Representative Cole stated: "The amendment that I have proposed is to the effect that every application for a patent in this field must carry with it a sworn statement by the applicant telling the time and circumstances and conditions under which this invention or discovery was conceived, and if that information discloses that it was during the course of any employment by the Atomic Energy Commission or employment by a contractor of the Commission or in any relationship whatever with the Federal Government that then the Commission may deny to that applicant the right of a patent and declare that that patent is public property—based upon the argument that it was conceived in the course of an association with the Government which was supported by public funds. That to me accomplishes the objective. It prevents anybody at all—everybody whatsoever who has been engaged in this program from obtaining a patent in the nonmilitary field of atomic energy, if that invention or discovery was conceived during the course of any association or relation with the Government." 100 CONG. REC. 11722 (1954).

[47] In this connection, see also the testimony of William Mitchell, AEC General Counsel, in *Hearings before the Joint Committee on Atomic Energy on Development, Growth, and State of the Atomic Energy Industry*, 84th Cong., 2d Sess., pt. 1, at 194, 197-99 (1955).

[48] Section 152 also provides that, in the event of a controversy between the AEC and the inventor concerning whether the invention was "made or conceived in the course of, in connection with, or under the terms of any contract, subcontract, arrangement, or other relationship with the Commission entitling the Commission to take title to the application or the patent," then such controversy is to be determined by the Board of Patent Interferences, subject to appeal to the Court of Customs and Patent Appeals.

[49] See 68 STAT. 937, 42 U.S.C.A. §2134 (Supp. 1954).

[50] See 68 STAT. 936, 42 U.S.C.A. §2133 (Supp. 1954).

[51] During the debates, Representative Cole, then Chairman of the Joint Committee on Atomic Energy,

Even if this legislative history can safely be relied upon, however, it does not solve the problem of how much more—or, indeed, how little more—there need be before the licensee finds himself enmeshed in section 152. For example, in the ordinary course of arranging for a license from the Commission, consultations may take place between the prospective licensee and the Commission which result in suggestions from the Commission as to the most feasible means of carrying out the proposed project. Will the acceptance of such suggestions create an "arrangement, or other relationship" which catches him up in the section 152 net? Or if, after obtaining the license, the licensee later consults with the Commission concerning technical problems and decides to follow suggestions which the Commission makes, has section 152 then cast a cloud upon all his patent rights in the field? And will the Commission come to the conclusion—as it intimated early in 1955[52]—that a licensee who also has access to restricted data is thereby brought within the scope of section 152?

These are only a few of the types of problems which section 152 creates. Most assuredly, there are many more. Some of them, moreover, arise in connection with what would otherwise be regarded as the routine effort to meet procurement needs of the Commission and its contractors. How is a company in the atomic energy field to be able to know that—even if the reach of the terms "contract," "subcontract," and "arrangement" has been successfully avoided—it has still not become involved in some "other relationship with the Commission"? I am not unmindful of Judge Cardozo's caution that "overemphasis of certainty may carry us to the worship of an intolerable rigidity."[53] But surely here in section 152 we are confronted with a kind of harassing uncertainty that is without purpose or utility.

Mr. Ooms has indicated that anyone who writes a letter to the Commission may have to worry about whether he is in trouble under section 152.[54] This is perhaps an exaggeration, but unfortunately not a large one. And, equally unfortunately, the comment might also be applicable to certain types of letters one might write to a

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stated: "It is not intended that section 152 should cover licensees unless in some other respects they do have an association with the Commission by reason of being a contractor or subcontractor or having money given to them by the Commission. But the mere fact of a person having a license does not mean necessarily that the product of his operation, if a patent should flow, would become publicly owned.

"While section 152 clearly prohibits the granting of patents on any invention or discovery in the atomic field 'made or conceived under any contract, subcontract, arrangement, or other relationship with the Commission,' it would be necessary to strain this language to blanket within the prohibitions those persons whose sole relationship with the Commission is a license granted by the Commission or the use under license of some special nuclear material owned by the Commision." 100 CONG. REC. 13783 (1954).

Senator Hickenlooper, then Vice Chairman of the Joint Committee, also stated: "It should be noted that this provision was not intended to apply to licensees of the Commission or to persons doing independent work, involving only a Commission security clearance, and not contractual arrangement." *Id.* at 14344.

[52] See testimony of William Mitchell, AEC General Counsel, on February 4, 1955, in *Hearings*, *supra* note 47, pt. 1, at 199-200.

[53] BENJAMIN N. CARDOZO, THE GROWTH OF THE LAW 19 (1924).

[54] See Ooms, *supra* note 8, at 284-85.

commission contractor. Indeed, section 152 difficulties may sometimes be lurking in the most innocent kinds of telephone calls.[55]

There are two ways of trying to deal effectively with the host of problems created by section 152. One is the obvious suggestion that this section of the law might be promptly amended. If any statutory provisions at all are needed to deal with inventions conceived during commission contracts—and it is extremely doubtful that they are, particularly in view of the general success with which the AEC has administered the patent clauses in its contracts and subcontracts[56]—then section 152 could be amended so as to confine its scope to the essentials and, at the same time, clearly free from its threat those activities that ought not to be covered. But the prospect for an early legislative solution is not necessarily hopeful. The patent provisions of the act, it will be recalled, are among its most controversial features. Genuine difficulties might stand in the way of trying to open up section 152 without at the same time putting up for re-examination all the patent provisions of the act. And certainly, it would not be suprising to find in the Congress a disposition not to undertake any such general re-examination of the hard-fought patent provisions until more actual experience has been accumulated under the enactment of 1954.[57]

There is also available another remedy, and this one would not require legislative change. It does, however, call for boldness and clarity of action on the part of the Commission. The waiver power conferred upon the Commission by section 152 is, as we have seen, a very broad authority. The Commission "may waive its

[55] Section 152 also contains some rather complex and onerous procedural provisions which are intended to implement its substantive features. These procedural provisions are bound to create a number of problems for everyone, including particularly the Patent Office, but they are minor irritations as compared to the major substantive uncertainties that have been discussed.

[56] For a general description of the types of AEC patent clauses used in its contracts following the 1946 act, see AEC FIFTH SEMIANNUAL REP. 150 (1949); and also the testimony of William Mitchell, AEC General Counsel, in *Hearings, supra* note 47, pt. 1, at 193. The patent clauses undoubtedly will need some overhaul in the light of the purposes and provisions of the 1954 act; indeed, this by now may be somewhat overdue. But there is no ground for believing that the provisions of §152 would provide any assistance or helpful guidance for that overhaul. It should also be noted that §159 of the 1954 act expressly declares: "Nothing in this Act shall affect the right of the Commission to require that patents granted on inventions, made or conceived during the course of federally-financed research or operations, be assigned to the United States." 68 STAT. 948, 42 U.S.C.A. §2189 (Supp. 1954).

[57] At the time the compulsory licensing provisions were finally accepted by the House (see note 44 *supra*), Representative Cole stated that the Managers on the Part of the House were accepting the Senate's position on the understanding that the problem would be re-examined at the beginning of the next session of Congress. See 100 CONG. REC. 14871 (1954). Representative Cole did introduce a bill at the next session which would have repealed the compulsory licensing provisions, and would also have amended §152 so as to greatly restrict its scope and eliminate many of the troublesome problems that are here being discussed. See H.R. 5167, 84th Cong., 1st Sess. (1955). See also Cole, *Patenting Nuclear Developments*, Nucleonics, April 1955, pp. 31, 34, where Representative Cole states, with reference to §152, of which he himself was the sponsor: "Ironically, under the pressure of zealously trying to protect the normal American patent system, too much was written into this section." During the first session of the Eighty-fourth Congress, the Joint Committee on Atomic Energy did not take action on either H.R. 5167 or any other patent proposals. See also Representative Cole's address of September 22, 1955, where, in addition to reiterating his vigorous opposition to the compulsory licensing provisions, he said with reference to §152: "Unfortunately, there was insufficient opportunity for full discussion of this section and the past year has shown that this section needs to be revised." ATOMIC INDUSTRY REP. 51:86 (1955).

claim" under such circumstances as it "may deem appropriate." In connection with the Access Permit Program, the Commission has already determined that under section 152 it may properly exercise this waiver power in advance.[58] Had the Commission not done so in the case of the Access Permit Program, it is possible that the whole program would have faltered miserably. Similarly, the Commission appears to have it within its power—through regulation and general policy interpretations, as well as through rulings in particular cases presented—to determine in advance the general classes of cases in which the waiver power is to be exercised under section 152. This would probably involve a considerable administrative burden for the Commission. But that is a small price to pay for being relieved of the appalling uncertainties which section 152 will otherwise create. Somewhat in the alternative, the Commission could make a more general determination to waive the Government's rights under section 152 in all situations, except for specific cases where the Commission gives express notice in advance that this general waiver would not be deemed applicable. Thus, in one way or the other, it seems possible that the Commission itself, by heroic efforts, can overcome the unfortunate consequences of this poorly drafted section of the act.

[58] This is the Access Permit Program which is described in AEC EIGHTEENTH SEMIANNUAL REP. 102-03 (1955), and is discussed elsewhere in this symposium. See Green, *Information Control and Atomic Power Development*, *supra*, 91-112. In the access permits which are being issued, the Commission includes the following advance waiver:

"In issuing the Access Permit, the Commission hereby waives, under Section 152 of the Atomic Energy Act of 1954, (1) its rights in inventions or discoveries made or conceived in the course of, in connection with, or resulting from access to confidential restricted data provided under the terms of this Access Permit, and (2) its rights, except an irrevocable royalty-free, non-exclusive license for Governmental purposes, in inventions and discoveries made or conceived and which result from access to secret restricted data obtained in the course of, in connection with, or under the terms of this Access Permit."

PUBLIC POWER AND ATOMIC POWER DEVELOPMENT

HERBERT S. MARKS*

I

A jumble of questions of law, politics, public opinion, economics, and ideology make the subject of public power a rich and confused field of debate. This paper is not concerned with the merits of that debate; it is concerned rather with a lawyer's appraisal of the Atomic Energy Act of 1954 as that law relates to public-power issues. In making such an analysis, it is first necessary to describe the position which public and private power now occupy in the economic system, entirely apart from atomic energy. Next, it is important to know the part which federal law and policy have played in producing these conditions. The relation between federal power policy of the past several decades and atomic energy can then be discussed. And finally, it will be possible to analyze the Atomic Energy Act of 1954 as an expression of federal power policy in its bearing on public and private power.

II

Power supply in the United States is organized on the following lines:[1]

About sixty-five per cent of the country's electric service is furnished by private utility systems. Ordinarily, each private operating company enjoys a monopoly in a defined territory, and usually, each private utility maintains plants to generate power, transmission systems to carry it to centers of urban or rural use, and distribution systems to make delivery to ultimate consumers in the company's service area. Monopoly in given service areas and integration of large-scale generation with transmission and distribution represent the most economical means of providing electric service, whether supply is public or private.

Nearly twenty per cent of the country's electric service is furnished by federal and local publicly owned systems and cooperatives. (While cooperatives are owned by their member-consumers and regard themselves as private agencies, the utilities

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[1] Except as otherwise noted, all of the statistical data about power supply, past and present, are derived from EDISON ELECTRIC INSTITUTE STATISTICAL BULLETIN FOR THE YEAR 1954, ELECTRIC UTILITY INDUSTRY IN THE UNITED STATES (1955). Data about power supply can be expressed in a variety of terms, such as power capacity, energy output, etc. The percentages used in this paper to describe the relative positions of public and private power are based upon capacity figures. Somewhat different percentages would be obtained if energy output were employed; but the trends indicated would not be materially different.

consider them a part of the public-ownership group). The form of organization among these public systems is much less uniform than among the private companies. For example, in the Tennessee Valley region, the TVA generates power which it transmits and sells to large industries and wholesales to municipally owned distribution systems or cooperatives for sale at retail to ultimate consumers. In Nebraska, where there are no longer any private utilities, a group of state agencies generates, transmits, and distributes power to all consumers in the state. In the Northwest, the Bonneville Power Administration of the Department of the Interior, as marketing agency for Bonneville, Grand Coulee, and other federal hydro-electric projects, is the largest single source of power at wholesale, transmitting and selling it to private utilities, to large industries, to municipal and other publicly owned systems, and to rural cooperatives. Other agencies of the Department of the Interior perform functions similar to the Bonneville Power Administration (but on a lesser scale) in the Southeast, the Southwest, and the Far West. And scattered through the country are still other public and cooperative systems, ranging in size from the large urban systems of the city of Los Angeles and the important REA generation, transmission, and distribution cooperatives to the many small municipal systems and rural cooperatives which exist as islands in the midst of territory served by large private utilities and which frequently depend upon such utilities for their source of wholesale power.

The remainder of the power supply of the country is accounted for by industrial companies, mines, railroads, and street railways which generate for their own use. This segment of the total supply (called self-generation) is not important in relation to the public-versus-private-power controversy. For economic reasons, the proportion of power requirements supplied in this way has been slowly declining for many years.

In contrast, since 1932, public power systems and cooperatives have increasingly supplied a greater portion of the market for electric service. In 1932, and for a number of prior years, public power accounted for only four to five per cent, as compared with today's twenty per cent; private utilities accounted for seventy-five per cent, as compared with today's sixty-five per cent; and self-generation accounted for twenty per cent, as compared with today's fifteen per cent.[2] In fact, apart from the absolute increase in the use of electricity, this great comparative growth of public and cooperative systems is the most striking feature of the period.

Many factors have contributed to this phenomenon, but one in particular stands out. Between 1932 and about 1945, federal power policy constantly encouraged the public-power movement by making newly available to it hydro-electricity. Federal hydro-electricity now comprises nearly half of all the publicly owned supply—or nearly ten per cent of the total electric supply, as compared with less than one per cent in 1932. The TVA and the power agencies of the Department of the Interior

[2] All of these data are, of course, relative. The over-all power capacity in the United States has approximately quadrupled since 1932, and the present positions of public and private systems represent their respective shares in a greatly enlarged market.

all had their inception in hydro-electric projects, and except for the TVA, all of them still maintain their hydro-electric character. Even the important state enterprises, like those in Nebraska, received their initial impetus through PWA loans and grants to construct locally owned hydro-electric dams.[3]

The marked trend to public power which began in the 30's with the New Deal had, however, slowed down by the close of World War II. Since 1945, for example, there has been no significant territorial expansion by TVA[4] and few major territorial expansions by other public agencies.[5] It may be an oversimplification to suggest that the relative stability between public and private power in sharing the total market since the close of the war is the result of a change in political climate. But since the end of the war, Congress has been less willing to authorize entirely new federal hydro-electric projects, one of the prime forces in the public-power movement in the 30's and early 40's. This was true even while President Truman was in office and before the outright opposition of the present administration to expansion of new federal power developments.[6] And although public power's share of the market rose from about seventeen per cent in 1950 to nearly twenty per cent in 1954, most of this increase is explained by the immense amounts of power which, with the beginning of the Korean war, the TVA supplied to defense loads, especially in the Atomic Energy Commission installations in Tennessee and Kentucky.[7]

III

The Roosevelt-Truman administrations favored public development of water resources; but that policy, in itself, is not enough to account for the present strength

[3] For a general account of the Nebraska experience, see CLARENCE A. DAVIS, NEBRASKA'S PUBLIC POWER EXPLAINED (1949); King, *Nebraska, the Public Power State*, 39 PUB. UTIL. FORT. 357 (1947). For a history of federal power developments, first as seen in the Truman administration and later as seen in the current administration, see 1 PRESIDENT'S WATER RESOURCES POLICY COMMISSION, A WATER POLICY FOR THE AMERICAN PEOPLE 219 *et seq.* (1950); 2 COMMISSION ON ORGANIZATION OF THE EXECUTIVE BRANCH OF THE GOVERNMENT [HOOVER COMM'N], WATER RESOURCES AND POWER 277 *et seq.* (1955).

[4] See TVA ANN REP. 2 (1955).

[5] Final acquisition of private utilities by the public systems in Nebraska was concluded in 1947. See note 3 *supra*. And in 1947, the Sacramento Municipal Utility District acquired the Pacific Gas and Electric Company system in the Sacramento area. See SACRAMENTO MUNICIPAL UTILITY DISTRICT ANN. REP. 3 (1954). The only subsequent acquisition of major significance, however, has been the City of Seattle's purchase in 1951 of a competing private system in that city. See CITY OF SEATTLE DEPARTMENT OF LIGHTING ANN. REP. 14 (1954).

[6] See, *e.g.*, *Congress Rejects Most New Power Projects*, Public Power (official publication of the American Public Power Ass'n), Aug. 1952, p. 11; *Power Facilities Slashed*, Rural Electrification Magazine, Aug. 1952, p. 23. Congressional inaction paved the way for private development of the Roanoke Rapids hydro-electric site under a license from the FPC and over the strenuous objection of President Truman's Secretary of the Interior. See United States *ex rel.* Chapman v. FPC, 345 U.S. 153 (1953). The present administration has voiced no opposition to the issuance of an FPC license for the private development of the Hell's Canyon project. See In the Matters of Idaho Power Co., FPC Opinion No. 283 (Aug. 4, 1955). Of course, existing federal systems have continued to expand capacity to supply the increasing demands in their existing service areas. And since 1948, REA loans to cooperatives to establish their own generating and transmission systems have been greatly speeded up. See *e.g.*, REA ANN. REP. 13 (1948); *id.* at 5 (1950). The result of these REA loans, however, has been less to invade private utility service areas than to supplant purchase from utilities at wholesale with power generated by the cooperatives themselves. See, *e.g.*, Kansas City Power & Light Co. v. McKay, 225 F.2d 924 (D.C. Cir. 1955).

[7] See TVA ANN. REP. 3 (1955).

and size of public power systems. The huge Boulder project of the Hoover administration was also a federal development of water resources. There, the Government built the Hoover dam but arranged with existing local public and private agencies to divide the water power between them and deliver it with their own transmission systems to their respective market centers. The policies followed with the Hoover Dam, accordingly, did not significantly alter the territorial balance between public and private groups.[8]

The Roosevelt-Truman administrations followed different policies, however. Federal agencies were used both to build dams and market the power from them. Legislation for hydro-electric development was almost always accompanied by a requirement that in the sale of power, preference must be accorded to local publicly owned systems and cooperatives.[9] In order to make the preference effective, the legislation sometimes authorized construction of federal transmission lines to bring the power to the local markets.[10] In order to meet the claim of private utilities that such transmission lines resulted in wasteful duplication of facilities, the idea of "wheeling" was conceived. Under this concept, the federal government refrained from building transmission lines, provided the utilities used their own transmission systems to deliver federal power to preference customers for the account of the Government and at a reasonable carrying charge.[11] This combination of federal policies assured many existing public systems of a new source of power and relieved them of dependence on uneconomic generating plants of their own or dependence on purchases from private companies, which were frequently hostile to the municipal distribution systems to which they sold power at wholesale. Most important, however, is the fact that this federal supply was cheaper than alternative private sources.

It is not within the scope of this paper to deal with the controversy over whether federal hydro-electricity was cheap because it was subsidized by appropriations, tax immunity, and the like; whether it was cheap because it was intrinsically low-cost, efficiently produced water power; or whether the private companies maintained excessively high rates or have received offsetting advantages through the rapid

[8] See I COMMISSION ON ORGANIZATION OF THE EXECUTIVE BRANCH OF THE GOVERNMENT [HOOVER COMM'N], *op. cit. supra* note 3, at 94-95 (1955).

[9] See, *e.g.*, 48 STAT. 64 (1933), as amended, 49 STAT. 1076 (1935), 16 U.S.C. § 831i (1946); 50 STAT. 733 (1937), as amended, 54 STAT. 47 (1940), 16 U.S.C. § 832c(a) (1946); 52 STAT. 405 (1938), 16 U.S.C. § 833c (1946); 58 STAT. 890 (1944), as amended, 61 STAT. 501 (1947), 16 U.S.C. § 825s (Supp. 1952). Precedent for these recent statutory preferences is supposed to reside in the Reclamation Act of 1906, 34 STAT. 117, 36 STAT. 930 (1911), 43 U.S.C. § 522 (1946). Whether this early preference clause had the same purpose as the more recent statutes is now disputed. *Compare* the testimony of Clarence A. Davis, *Hearings before the Subcommittee of the Senate Committee on the Judiciary on Power Policy*, 83d Cong., 2d Sess., pt. 2, at 490 (1954), *with* Lepawsky, *Why Public Power Is Here to Stay*, The Reporter, Oct. 6, 1955, p. 33.

[10] See, *e.g.*, Tennessee Valley Authority Act of 1933, 48 STAT. 60, as amended, 49 STAT. 1075, 1080 (1935), 55 STAT. 599 (1941), 16 U.S.C. § 831c(i), (j) (1946); as to the Bonneville project, see 50 STAT. 732 (1937), as amended, 59 STAT. 546, 547 (1945), 16 U.S.C. § 832a(b) (1946).

[11] As exemplifying the congressional attitude on wheeling, see S. REP. No. 1803, 82d Cong., 2d Sess. 2 (1952).

amortization privilege. What matters in the result is that municipalities and other public organizations were encouraged by the low cost of federal power and by complementary federal policies to enter the power business on their own account, and numerous new municipal and other public and cooperative systems were organized.

In the early days of the New Deal, these new public and cooperative organizations were also offered the advantage of low-cost financing through PWA loans and grants and through REA low-cost loans. Some of the new agencies, as in the case of the rural cooperatives, began to serve farm areas which had been neglected by private companies. Municipalities, as in the TVA area, planned distribution systems of their own, and by thus threatening to compete with private companies in the same areas, made it necessary for the latter to sell out their systems to the municipalities.[12]

In tracing the recent strength of public power to federal policy, it would be a mistake to minimize the part which purely local agencies have played and will continue to play in the public-power movement. Los Angeles, Seattle, Tacoma, and numerous other municipalities had publicly owned power systems long before the New Deal.[13] In the early days of the century, municipally owned systems accounted for much more than five per cent of total supply, which was their share in the years just prior to 1932.[14] The New York State Power Authority's recent entrance into the Niagara-St. Lawrence development may stimulate future expansions of public power in the Northeast comparable to those encouraged elsewhere by federal activity during the 30's and the 40's.[15] Rural electric cooperatives, which now serve more than half of the farms in the country, would be an important force even if REA ceased to exist.

It is also a mistake to dismiss public power as the invention of radical or Democratic theorists and politicians. Nebraska, an overwhelmingly Republican state, and now entirely served by public power, had thirty-five to forty municipally owned power systems prior to 1932.[16] And it was the late Senator Robert Taft who, in response to complaints that the REA and the cooperatives were socialistic institutions, is reported to have said that rural electric cooperatives are as American as the Fourth of July.

Finally, it is a mistake to assume that federal power policy and local public ownership always go hand-in-hand. Conflicts occur between different public-ownership groups.[17] But when national legislation raises issues of public versus private

[12] The story of these activities is told in the unsuccessful litigation of the utilities to block federal loans and federal power projects. See, *e.g.* Alabama Power Co. v. Ickes, 302 U.S. 464 (1938); Tennessee Electric Power Co. v. TVA, 306 U. S. 118 (1939).

[13] See the testimony of Leland Olds, *Hearings before the Joint Committee on Atomic Energy on Development, Growth, and State of the Atomic Energy Industry*, 84th Cong., 1st Sess., pt. 3, at 513, 516 (1955).

[14] See Lepawsky, *supra* note 9, at 36.

[15] *Cf.* the testimony of Leland Olds, in *Hearings before a Subcommittee of the Senate Committee on Public Works on the Niagara River Power Project*, 84th Cong., 1st Sess. 49-69 (1955).

[16] See DAVIS *op. cit. supra* note 3, at 14.

[17] See Davis, *A New Look at Federal Power Policy*, 53 PUB. UTIL. FORT. 135 (1954).

power, the public agencies tend to stand together. This was the case in the debate on the Atomic Energy Act of 1954. The debate was concerned with precedents in federal power law and policy and the theories associated with them. Generally speaking, the public agencies found their supporters among the Democrats rather than among the Republicans.

IV

A plausible case can be made for applying to atomic energy the rationale of the policies established in the Roosevelt-Truman administrations for developing and marketing water power. The genesis of the federal interest in hydro-electric projects is the commerce, government property, and war powers clauses of the Constitution.[18] The legal theory most often employed relates to the right of the Government in navigable streams under the commerce clause. In thus exercising its right to improve navigation by construction of dams, the Government is held to realize a proprietary interest in the falling water at the dams. And generation of power therefrom by federal agencies and delivering it to market by transmission lines are regarded as an exercise of rights under the government property clause,[19] as is accordance of a preference to public agencies and cooperatives in disposing of the power at wholesale.

In their application, these concepts allow ample room to accommodate other purposes. Thus, a federal dam may be built on a stream once navigable, even though improvement of navigation is no longer as important as production of power.[20] And creation of federally owned hydro-electric power and its delivery and sale to preference customers as a yardstick to supplement regulation of private utility monopolies has been justified for political, social, and economic reasons, apart from orthodox constitutional doctrines.[21] Development of water power by public rather than private agencies has further been pressed on the theory that water is a natural resource in which all the people have an interest, and their interest can best be realized by giving preference to public authorities in exploiting hydro-electric sites.[22] The logic of the yardstick idea can be applied as well to steam plants, and the natural resources theory can be applied as well to coal, oil, and gas, the other sources of energy. But historically, the conventional fuels have been exploited by private agencies, and the constitutional bases for federal development of water resources is absent in the case of these fuels.

The analogy between nuclear energy and water power, on the other hand, suggests itself because the atomic enterprise began as a federal monopoly. The wartime work, conducted as a defense measure exclusively under government auspices, was continued under the McMahon Act without significant change, except to replace

[18] See 3 PRESIDENT'S WATER RESOURCES POLICY COMMISSION, WATER RESOURCES LAW 6 (1950).
[19] Ashwander v. TVA, 297 U.S. 288 (1936).
[20] Arizona v. California, 283 U.S. 423 (1931).
[21] See, *e.g.*, *Hearings before the Joint Committee on Atomic Energy on S. 3323 and H.R. 8862*, 83d Cong., 2d Sess., pt. 1, at 530 (1954).
[22] See *id.* at 354.

army direction with a civilian agency.[23] As enacted in 1946, the first atomic energy law seemed likely to reinforce the analogy between atomic power and water power. There is no evidence that this was deliberate on the part of Congress; in fact, it was with reluctance that the Congress adopted the law which continued the public monopoly that had grown up during the war.[24] In the interests of safety and security, however, private production and ownership of fissionable materials as well as private ownership and operation of nuclear reactors was forbidden. And, by reason of its title to all fissionable materials, the Government had, and still has, a proprietary interest in nuclear fuel which can be likened to its proprietary interest in the falling water of navigable streams. Moreover, by reason of the enormous financial investment of the Government in atomic energy, it has been possible to argue that nuclear energy should be considered a resource which belongs to all the people and which, like water power, should be publicly developed, or very strictly regulated.

At the time the McMahon Act was being debated, arguments of this kind were heard, but they then had no practical significance. The framers of the 1946 law were able to put to one side the always stormy power issue. Economically competitive atomic power was then many years off, and Congress concentrated on difficult international and domestic questions which had to be met immediately, without forcing other issues which could be deferred.

In 1954, despite considerable research and development work by the AEC on power reactors, economical atomic power was still only a prospect. But, by that time, the technology had advanced to the point where economical nuclear power was much more plainly in view than it had been in 1946. Not only the utilities, but many other industrial concerns expressed an enthusiastic interest in participating in atomic work, provided the law were altered to permit them to work under genuinely private auspices rather than as hired hands of the Government. In agitating for a change in the law, private utilities and other industrial groups sought the right to own nuclear power plants, to own or lease fissionable materials from the Government, and to patent inventions. They realized that safety and security required that the Government should at least regulate private activities, and they offered no objection to the idea that ownership of nuclear reactors and use of fissionable materials should be permitted only under license by the Government.[25]

Discussion of power issues comprised a large part of the congressional hearings and debate on the 1954 act. At first, public-power groups suggested that any legislation to weaken the federal monopoly was premature. This theme runs through the testimony of representatives of such groups and is reflected in the separate report of Congressmen Holifield and Price, members of the Joint Committee on Atomic Energy. Advocates of public power may have hoped that by preserving the federal

[23] See the Atomic Energy Act of 1946, 60 STAT. 755, 42 U.S.C. § 1801-19 (1946).

[24] See JAMES R. NEWMAN AND BYRON S. MILLER, THE CONTROL OF ATOMIC ENERGY 3-4 (1948).

[25] See the testimony of representatives of utilities and of other industries, *Hearings before the Joint Committee on Atomic Energy on Atomic Power Development and Private Eenterprise*, 83d Cong., 1st Sess. (1953); *Hearings*, *supra* note 21, pt. 1.

monopoly, atomic energy might one day come to play the same role in strengthening and extending public ownership as federal hydro-electric projects had played in the past. Whether or not this hope was entertained, these groups argued that the technology was not yet sufficiently developed and the political, economic, and social issues had not been sufficiently explored to warrant legislation opening atomic work to private concerns. At the same time, they urged vigorous federal research and development to improve the technology of atomic power production, pointing out that atomic energy was a national resource not to be "given away."[26]

Private groups, however, were able to exert much more influence in the legislative struggle. Atomic power study groups composed of private utilities and industrial concerns were instituted in 1951 and aggressively pursued the subject thereafter.[27] In this way, they managed to learn enough about nuclear technology to speak with confidence about the need for legislation and the form it should take. Whether through lack of enterprise or lack of funds on the part of public groups or lack of sympathetic reception of them by the AEC, public power agencies, up to the latter part of 1953, had not taken part in these studies.[28] The private groups which had first seized and pressed opportunities to learn about the new field were, thus, in a more advantageous position.

By 1954, moreover, most of the reasons which in 1946 impelled the Congress to legislate a federal monopoly had significantly altered.[29] A powerful tide of opinion favored opening up atomic energy to private development. The Atomic Energy Act of 1954 was the natural result.[30]

V

As soon as the ineffectual effort to defer any legislation to open up atomic work to industry was swept aside, one issue of profound consequence in the controversy over public versus private power was quickly settled. In July 1954, the Joint Committee on Atomic Energy agreed unanimously on a bill to permit private ownership of reactors and private use of fissionable materials.[31] By this action, private ownership of atomic power plants became possible, and an exclusive or predominantly public development of nuclear plants became improbable. The action of the Congress on other matters, however, did create conditions under which public and private power are enabled to maintain the same relative positions which they held prior to the 1954 act in the field of conventional power.[32] Whether, in the long run,

[26] See the testimony of representatives of public power systems and rural electric cooperatives, ***Hearings,*** *supra* note 25. See also *Separate Views of Representative Holifield and Representative Price on H.R. 9757,* H.R. REP. No. 2181, 83d Cong., 2d Sess. 106 (1954).

[27] See AEC SEVENTEENTH SEMIANNUAL REP. 26 (1955).

[28] See AEC FIFTEENTH SEMIANNUAL REP. 20 (1954).

[29] See HERBERT S. MARKS AND GEORGE F. TROWBRIDGE, FRAMEWORK FOR ATOMIC INDUSTRY 1-2 (1955).

[30] 68 STAT. 921, 42 U.S.C.A. §§ 2011-281 (Supp. 1954).

[31] See H.R. REP. No. 2181, *supra* note 26, at 5-6, 8-9.

[32] An extreme view has been expressed about the patent and power provisions of the Atomic Energy Act of 1954 by Adams, *Atomic Energy: The Congressional Abandonment of Competition,* 55 COLUM. L. REV. 158, 179 (1955). He calls the law "unwise, man-made, discriminatory . . . legislation which throttles competition and restricts opportunity." Obviously, the writer of this paper disagrees with

this will be the result depends, of course, on how the law is administered and on what further action Congress takes on the subject.

In summary, the main provisions of the Atomic Energy Act of 1954 relating to power policy are these:

1. Private agencies, public agencies, and cooperatives are all qualified under the 1954 act to own and operate power reactors and to obtain nuclear fuel for them. In order to operate reactors and get fuel, however, they must first be licensed by the AEC.[33] Under the McMahon Act, no agency, public or private (with the exception of the Commission itself), could own and operate a power reactor.[34]

2. Private and public agencies and cooperatives have an equal opportunity under the law to obtain noncommercial licenses for experimental power reactors.[35] The policy of the law is to give strong encouragement to all comers to engage in the research and development work necessary to advance the technology to a point where atomic power can compete with conventional sources of power.[36]

3. In granting commercial licenses for power reactors (presumably plants which are economically competitive with conventional power plants), the law stipulates that preference shall be given to public agencies and cooperatives as well as to high-cost power areas.[37] As to the preference to public agencies and cooperatives, this feature of the law appears to favor public power.

4. The AEC may itself build experimental power reactors and sell the power they produce.[38] It may also build reactors to make fissionable material, it may design them so that they will generate power as a by-product, and it may sell the by-

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Professor Adams. On patent questions, which are not dealt with in this paper, Professor Adams' appraisal should be contrasted with that of Casper W. Ooms. See Ooms, *Revision of the Patent Provisions —Good or Bad?*, in MINUTES OF THE THIRD ANNUAL CONFERENCE, ATOMIC ENERGY IN INDUSTRY, NATIONAL INDUSTRIAL CONFERENCE BOARD, NEW YORK CITY, OCTOBER 13-14, 1954, 279 (1954); and *Is the New Atomic Energy Act a Patent Give-away?*, a paper delivered at Conference on Atomic Energy for Industry, Atlanta, Ga., Oct. 28, 1954. In the same vein, see also Boskey, *Patents Under the New Atomic Energy Act*, 36 J. PAT. OFF. SOC'Y 867 (1954).

[33] See §§ 53, 103, 104, 68 STAT. 930, 936, 937, 42 U.S.C.A. §§ 2073, 2133, 2134 (Supp. 1954).

[34] See §§ 4(b), 4(c)(1), 7(a), 5(a)(2), 5(a)(3), 5(a)(4), 60 STAT. 759, 764, 760 (1946), 42 U.S.C. §§ 1804(b), (c)(1), 1807(a), 1806(a)(2)-(4) (1946). In the debate on the 1954 act, there was an unsuccessful effort to make commercial licensees of atomic plants subject to all the conditions of licensees under the Federal Power Act. See *Separate Views of Representative Holifield and Representative Price*, H.R. REP. No. 2181, *supra* note 26, at 120-22. Instead, the law simply makes interstate sales of nuclear energy subject to the usual regulation of such sales by the FPC. 68 STAT. 960, 42 U.S.C.A. § 2019 (Supp. 1954). However, even had the separate views of Representatives Holifield and Price prevailed, it probably would not have deterred private companies from seeking licenses. They prefer to avoid the restrictions of the Federal Power Act. See United States v. Appalachian Electric Power Co., 311 U.S. 377 (1940). But they are no longer discouraged thereby from undertaking hydro-electric projects. See cases cited *supra* note 6.

[35] See § 104, 68 STAT. 937, 42 U.S.C.A. § 2134 (Supp. 1954). It is possible to argue that public and cooperative agencies are entitled to treatment in the nature of a preference in connection with licenses for experimental power reactors. See MARKS AND TROWBRIDGE, *op. cit. supra* note 29, at 40-41. However, the Commission has construed the law (and this is probably in keeping with the intention of the Congress) as treating all applicants for noncommercial licenses alike. See AEC Notice of Proposed Rule Making, 20 FED. REG. 2486 (1955); and Note, *id.* at 2489.

[36] *Cf.* H.R. REP. No. 2181, *supra* note 26, at 9.

[37] See § 182(c), 68 STAT. 954, 42 U.S.C.A. § 2232(c) (Supp. 1954).

[38] See § 31(a)(4), 68 STAT. 927, 42 U.S.C.A. § 2051(a)(4) (Supp. 1954).

product.[39] But the law prohibits the AEC from building atomic power plants for the sale of power commercially if such plants are unrelated to research or to production of fissionable material.[40]

5. In selling power from its own experimental reactors or as a by-product of its production reactors, the law stipulates that the AEC must give preference to public agencies, cooperatives, and high-cost power areas.[41]

The discussion of the law which follows is concerned chiefly with the preference features of the law.

The preference in favor of public agencies and cooperatives in granting commercial licenses is analogous to the preference which the Federal Power Act gives to public applicants for licenses to build hydro-electric projects.[42] It is difficult to foresee whether this preference in the Atomic Energy Act of 1954 will be more significant than its analogue. Nature has created only a limited number of desirable hydro-electric sites, and the FPC has construed its law to mean that, other things being equal, competition for a license between a public and a private agency will be resolved in favor of the former.[43] In the case of atomic power, however, the number of plants is limited only by the markets for power and the availability of nuclear fuel. The economics of the utility business has usually dictated that any given market should be served by a single electric system, public or private. As far as markets are concerned, therefore, a preference in granting commercial licenses to public agencies and cooperatives is not likely to be important unless public power seeks to invade an area already served by a private utility. But even if public groups attempt to take advantage of the preference in this way, their efforts may be neutralized if there is enough nuclear fuel available for both a public and a private plant. And all the present indications are that nuclear fuel will become so plentiful in relation to the probable market that public agencies will not need to invoke their preference right to commercial licenses. For the time being, however, the question is academic, as the technology is not yet sufficiently advanced to permit construction of atomic power plants which require a commercial license.

A number of reactor designs are now being tried out by the AEC in its own experimental program.[44] Various power companies and manufacturers have well-advanced plans for building experimental reactors under license from the Commission.[45] These private reactors all qualify for noncommercial licenses, even though some of them will produce from a hundred to two hundred thousand kilowatts, amounts of power comparable to the capacities of modern, conventional steam plants. Local public agencies and cooperatives also have plans for building

[39] See § 44, 68 STAT. 929, 42 U.S.C.A. § 2064 (Supp. 1954).
[40] *Ibid.*
[41] *Ibid.*
[42] *Cf.* 49 STAT. 842 (1935), 16 U.S.C. § 800 (1946). This provision of the Federal Power Act had its inception in the original Federal Water Power Act of 1920, 41 STAT. 1067.
[43] See *Hearings, supra* note 15, at 11.
[44] See AEC EIGHTEENTH SEMIANNUAL REP. 34 (1955).
[45] See *id.* at 41-42.

experimental power reactors of substantial size under license from the AEC.[46] As now presently construed by the AEC, the law gives no preference to public or co-operative bodies that wish to obtain licenses for experimental reactors, but, as will appear at a later point, the Commission has recently shown signs of willingness to grant some financial aid for such reactors.[47]

The preference which the law accords in the sale of power from AEC experimental reactors, or as a by-product of AEC production plants, is presently of doubtful value. Experimental power reactors will be high-cost or unreliable producers—otherwise they will be commercial plants, in which case the AEC is prohibited from building them. Public agencies are now fighting for recognition of their preference right to power from the AEC's experimental reactor at West Milton, New York.[48] In this fight, no substantial economic advantage is at stake. The West Milton plant produces an insignificant amount of dump power which cannot be relied upon to serve ordinary utility loads. It has been priced by the AEC at 3 mills per kilowatt-hour, a figure which bears no relation to its high cost, but is in line with the value of dump power.[49] Since an atomic kilowatt-hour is physically indistinguishable from a conventional kilowatt-hour, it may be assumed that the private and public utilities which are so eager to buy at wholesale and retail the power from the AEC's small experimental reactors see prestige rather than any economic value in the atomic kilowatt-hours. The public agencies also view the West Milton case as a situation in which they must assert their legal preference in order to establish a precedent in the administration of the law, especially their conception of a federal responsibility to arrange for wheeling in their behalf in order to make their preference effective.[50] But the AEC is building only one large-scale experimental reactor today—the plant at Shippingport, Pennsylvania, started under the McMahon Act; and at this plant, the high-cost experimental power was disposed of by arrangements with a private utility before the 1954 preference became law.[51]

It may be, however, that in the future the AEC will build other large experimental reactors.[52] Such reactors may produce sizable amounts of reliable power, and a new AEC with a different political orientation might price the power at a cost sufficiently lower than its real cost to make it attractive as compared with

[46] See *id.* at 42; also Bradburn, *Minnesota System Proposes Atomic Power Plant,* Rural Electrification Magazine, Aug. 1955, p. 13.

[47] See note 35 *supra.*

[48] See remarks of Senator Humphrey, 101 CONG. REC. 10945 (daily ed. Aug. 1, 1955); remarks of Representative Evins, *id.* at A5790 (daily ed. Aug. 3, 1955); Congressman Davidson charges AEC with Giving Private Utility "Inside Track," Press Release by Representative Irwin D. Davidson (N.Y.), Sept. 9, 1955; speech by Alex Radin, General Manager, American Public Power Ass'n, before the Municipal Electric Utilities Ass'n of New York State, Sept. 9, 1955.

[49] See AEC Release No. 663, July 13, 1955. *Cf.* speech by Alex Radin, *supra* note 48.

[50] See note 48 *supra,* especially Mr. Radin's speech.

[51] See AEC Release No. 526, March 14, 1954.

[52] See, *e.g.* S. 2725, 84th Cong., 1st Sess. (1955). This bill, submitted by Senator Gore, which is pending in committee, would authorize and direct the AEC to build six experimental power reactors, located in different geographical sections of the country, at sites selected with a view, among other things, to the need for electric generating capacity in the region of the sites.

alternative conventional sources. In that event, the preference rights of public and cooperative agencies would be valuable. It should be observed that even under the legislation of the 30's and the 40's, when federal policy strongly favored public and cooperative groups, the statutes prohibited federal agencies from making such baldly below-cost sales.[53] But the same result might be achieved under the provisions of the Atomic Energy Act of 1954 relating to "production" reactors.

The preference to public and cooperative agencies in purchasing by-product power from AEC production reactors could be important if any reactors of this kind were to be built. Britain's atomic power program is being launched with production plants which will make substantial amounts of plutonium for weapons and power as a by-product. In England, the plutonium is assigned an arbitrarily high value. The by-product power can then be priced at a figure which makes it competitive with conventional power.[54] The AEC has no plants of this kind, and today none are in prospect. There is little support in this country for following the British program. Our policy is to build and operate production plants designed solely to make fissionable materials, while experimenting with a large number of different reactors designed primarily to produce power. But a change in the political mood regarding power and atomic energy could alter this condition. Nearly all large power reactors, whether experimental or commercial, can produce substantial quantities of nuclear fuel as well as power. If the AEC should launch a new program of its own to build large reactors, it could treat them as production reactors, while designing them also to make substantial quantities of power, classified as a by-product. As in the case of the British program, the by-product power could be priced at a competitive figure. If such action were coupled with a federal policy of encouraging new public agencies, as in the 30's and the 40's, the result might be a resumption of the trend of public agencies to increase their relative share in the total power market. All of this is, of course, highly conjectural and, in any case, not likely to occur under the present administration.

Once the stage of experimentation is past and economically competitive power plants become feasible, the AEC is forbidden to build them. This prohibition was written into the law by members of Congress who wished to keep the AEC out of the power business. Supporters of public power had urged that instead of forbidding such activity by the AEC, the law should affirmatively authorize it to build commercial plants or commission other federal agencies to do so. They urged that marketing of the power be the responsibility of the Department of the Interior, pursuant to the Flood Control Act of 1944, which gives preference to public agencies and cooperatives. The so-called Johnson amendment was adopted by the Senate for this purpose, but it was killed in conference.[55] Had the Senate amendment become law,

[53] See, *e.g.*, the famous § 5 of the Flood Control Act of 1944, 58 STAT. 890, 16 U.S.C. § 825s (1946).

[54] See the White Paper, *A Programme of Nuclear Power*, CMD. No. 9389, at 4-5 (1955).

[55] See H.R. 9757, To Amend the Atomic Energy Act of 1946, 83d Cong., 2d Sess. § 45 (1954), as passed by the Senate, July 27, 1954; see also H.R. REP. No. 2639, 83d Cong., 2d Sess. 45-46 (1954), and H.R. REP. No. 2666, 83d Cong., 2d Sess. 47-48 (1954).

an administration pledged to the federal power policy of the Roosevelt-Truman administrations might have tried to invoke the authority to establish commercial plants to repeat, with atomic power, the process of extending public ownership which occurred with hydro-electric projects.

But the failure of the Johnson amendment and the prohibition on construction of commercial plants by the AEC or its federal nominees are not necessarily of great practical consequence. When commercial plants become feasible, the AEC or other federal agencies will be able to obtain enabling legislation and appropriations to build such plants, provided political conditions favor developments of that kind. On the other hand, even had the Johnson amendment been adopted, neither the AEC nor other federal power agencies could have invoked it without obtaining appropriations from Congress; and in most instances, a further congressional enabling act, in addition to the Johnson amendment, would have been necessary before a federal agency could have sought an appropriation for a commercial reactor.[56]

In addition to the provisions of the law which deal explicitly with power policy, there are others which are relevant to the subject. The Commission is required to fix a "fair" price for fissionable materials produced in the reactors of others, and is also authorized to furnish a variety of services and materials in aid of the reactor projects of others and to fix the price for them. The provisions of the law also permit the AEC to give services and to loan materials without charge in aid of experimental reactors, whether publicly or privately owned, as well as to give certain direct financial assistance to public and private agencies in carrying out research and development work associated with experimental reactors. And in the case of commercial reactors, whether public or private, the law requires the AEC to fix a "reasonable" charge for services and materials which it furnishes.[57]

Because the law is written in general and sometimes ambiguous terms, and because of the secrecy which surrounds the AEC's conduct of its affairs, there are obvious opportunities for hidden subsidies and for arbitrary action in granting subsidies through price-fixing or otherwise. In its actions to date, however, the AEC appears to have adopted policies on price-fixing and financial assistance to reactor projects which avoid hidden subsidies and arbitrary discrimination, either in favor of private reactors or in favor of those proposed by public agencies.[58]

In its initial actions on proposals for power reactors under the new law, the AEC sought to avoid any subsidy. Thus, in its first-round reactor program, the AEC

[56] As illustrative of the parliamentary process, see the following materials on the further enabling legislation necessary to authorize appropriations for new projects under the Atomic Energy Act of 1954: *Hearings before the Subcommittee on Authorizing Legislation of the Joint Committee on Atomic Energy*, 84th Cong., 1st Sess. (1955); H.R. REP. No. 787, 84th Cong., 1st Sess. (1955); 69 STAT. 291 (1955). See also MARKS AND TROWBRIDGE, *op. cit. supra* note 29, at 69-70. It is doubtful that § 272 of the Atomic Energy Act of 1954, 68 STAT. 960, 42 U.S.C.A. § 2019 (Supp. 1954), which was adopted as a partial substitute for the Johnson amendment, will assist federal power agencies in short-cutting the normal legislative process.

[57] For general discussion of these provisions, see MARKS AND TROWBRIDGE, *op. cit. supra* note 29, at 43-59.

[58] See *id.* at 45, 47.

approved two proposals of private groups which asked no substantial assistance from the Government, except in the form of insurance. At the same time, it rejected, provisionally, two proposals, one of a private group, the other of the Consumers Public Power District of Nebraska, because each sought substantial government aid.[59]

In the Commission's second-round reactor program, however, a policy of federal aid is clearly contemplated. It (1) invites proposals for small size reactors (5,000 kilowatts to 40,000 kilowatts); (2) holds out the prospect of substantial financial assistance to those who propose projects; and (3) expresses willingness to consider financial assistance in the form of AEC construction and ownership of the reactor phase of the project, with ownership of the conventional turbo-generator in a power agency or industrial concern.[60] On its face, this latter program is designed only to encourage experimental work on perfecting small nuclear power plants, a field where, to date, the technology has lagged behind that of the larger types. But the offer of financial assistance and AEC construction and ownership of the reactors could also operate in favor of public agencies, which are more interested than private utilities in small plants. The public bodies also have a greater need for government assistance because they are not as favorably situated as private companies in finding money for experimental work. Federal agencies must look to Congress for appropriations, and most of the state and municipal systems and the cooperatives are operated on the theory of selling power at cost, without profit, and, accordingly, do not build up reserves which can be used in research and development. Private utilities, on the other hand, are able to use their funds for experimental work and charge the costs to operating expense with a consequent tax deduction.[61]

Even if private companies do not seek help from the AEC in building experimental power plants, the public groups will certainly continue to seek such aid. They can argue that since the law gives them a preference in obtaining commercial licenses, they ought to be helped by the Government in conducting the experimental work which must precede the building of economically competitive plants. In the case of existing public agencies, this argument seems just now to be influencing actions of the AEC. The second-round small reactor program is one sign in this direction. Another is the recent decision of the Commission to reconsider the proposal by the Consumers Public Power District of Nebraska for a large experimental reactor on terms which would involve considerable financial assistance from the AEC.[62] But actions along these lines will not enable public agencies to invade markets now served by private companies. They will help public groups to begin to acquire experimental atomic power plants and to become experienced in the new technology.

In the analysis of the Atomic Energy Act of 1954 and its administration just concluded, it should be apparent that, in the view of this writer, the law favors private

[59] See AEC Release No. 674, Aug. 8, 1955.
[60] See AEC Release No. 695, Sept. 21, 1955.
[61] See *e.g.*, *Re* The Detroit Edison Company (Mich.) Docket No. 1282A-55.1, Mar. 23, 1955.
[62] See AEC Release No. 723, Oct. 27, 1955.

power—but primarily in the sense that it opened the field of atomic energy to private development and thereby made improbable an exclusively government development of nuclear energy, with the strengthening and enlargement of the public-power movement that would have resulted from such a course. The preferences won by public groups are, however, a balancing factor, although they are not likely to cause an early return to the trend of the 30's and 40's when public power occupied an increasingly larger proportion of the market. Rather, the net effect of these preferences will be to help public agencies hold their ground. In this respect, the law and its administration reflect the fact that public power groups are sufficiently strong politically to preserve their position, even in an administration that cannot be characterized as friendly to them.[63]

VI

Nearly everyone now realizes that nuclear power must be regarded as another form of energy which can ultimately take its place with coal, oil, gas, and falling water as a means of generating electric power. Atomic power, sooner or later, will become competitive with power produced from other sources of energy. At that time, it will supplement them. It is not likely soon to displace them.

Present use of power is expected nearly to double by 1965 and double again in the following decade. If these forecasts are realized, the United States will have on the order of 200,000,000 kilowatts of electric capacity in 1965 and 400,000,000 kilowatts in 1975. Predictions about the proportion of the new installations that will be atomic plants vary so widely, however, that they merely emphasize the uncertainty that surrounds the subject. One careful study concludes that the best guess that can be made as to the amount of atomic power likely to be in use in the United States by 1965 is a range somewhere between one and thirteen million kilowatts.[64] Looking still further ahead, the Director of the AEC's Reactor Development Division thinks it possible that by 1975 to 1980 the total amount of nuclear power in use in the United States may be as much as 100 million kilowatts.[65]

Meanwhile, the gradual evolution of the technology which is expected some day to make atomic energy competitive with conventional sources is taking place in a context of law and administrative policy which reflects the attitude of the present administration on the general subject of federal power policy. The administration has been careful to limit its explicit disapproval of public power to expansion of

[63] *Cf.* notes 60 and 61 *supra.* Also *cf.* Opinion of the Attorney General, concerning the proposal with the Georgia Power Company for the marketing of electric energy generated at the Clark Hill Reservoir Project, July 15, 1955; speech by AEC Chairman Strauss, *The Promises and Problems of Nuclear Power,* at Case Institute of Technology, AEC Release, Nov. 9, 1955; separate statements of Messrs. Brownell and Fleming, 2 COMMISSION ON ORGANIZATION OF THE EXECUTIVE BRANCH OF THE GOVERNMENT [HOOVER COMM'N], *op. cit. supra* note 3, at 3.

[64] See ATOMIC INDUSTRIAL FORUM, A GROWTH SURVEY OF THE ATOMIC INDUSTRY 1955-65, at 36 (1955). The forecasts in this survey are stated in terms of kilowatts of heat capacity. These terms can be translated into kilowatts of electric capacity by dividing by four.

[65] See speech by W. Kenneth Davis, *Capital Investment Required for Atomic Energy,* delivered at the International Conference on the Peaceful Uses of Atomic Energy, Geneva, Switzerland, Aug. 9, 1955.

federal activities. Its avowed policy is one of local option as between public and private agencies. Existing private systems are beginning work on experimental nuclear plants. Existing public systems will probably soon be building theirs. Manufacturers of power equipment are offering power reactors for sale to public and private systems in the same way that the manufacturers now supply the needs of public and private systems with conventional equipment. Accordingly, under today's law and policy, there is no indication that the relative position of the public and private systems will be altered by the emergence of atomic power. But power is always an explosive political issue. No one who is familiar with the history of the ups and downs of public and private power during the past half century is likely to predict that present law and policy represent the last word on the subject.

SOME INTERNATIONAL ASPECTS OF ATOMIC POWER DEVELOPMENT*

DANIEL WIT†

When eighteenth century man—and particularly the Englishman—first developed the ability to utilize coal for the production of steam power, the world entered the initial stages of what we now label The Industrial Revolution. At the beginning of the twentieth century, petroleum made its appearance as a fully feasible energy source and significantly affected that Industrial Revolution. In both instances, the results of these two triumphs in human technological achievement were not merely domestic, however, though national economies, national social relationships, national ideologies, and national political practices were greatly modified to different degrees and at different rates of speed. The entire character of international relationships and activities also underwent tremendous reformation. Certainly no one can contemplate the social revolutionary and anti-colonial forces which presently dominate relations between the industrial and underdeveloped areas of the world without simultaneously according recognition to the formative impact on those relations of these two great modern power sources. Today, we confront another major technological advance in the power field, and those of us who are seriously concerned with its potentialities must necessarily consider its international aspects alongside its domestic implications. For there certainly is little justification for believing that the role of atomic power in international affairs will be much less consequential than that of coal and petroleum. Even if such power does not, of itself, inaugurate a second Industrial Revolution, as some enthusiasts have predicted, its global effects and potentialities still remain considerable.

Americans, in particular, have a vital interest in the nonmilitary aspects of the "international atom." The reasons for this are twofold: on the one hand, our leadership position in international affairs compels attention to any development of the magnitude and possibilities of atomic power; on the other hand, this nation's great reserves of fossil fuels moderate the intensity of our desire for immediate domestic utilization of this new force in whose development we have pioneered and, thereby, promote both governmental and private attention to the ever-louder foreign demands

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for a opportunity to employ this latest technical achievement. The necessities of world leadership thus combine with the benevolence of nature to focus a considerable amount of American attention on the international political and commercial significance of atomic power. In particular, in this age of constant threat to national survival, the advent of atomic power constitutes a special challenge to governmental policy. It, therefore, seems only proper that an exploratory discussion of this type enter the complex and ill-defined arena of international affairs through the passageway afforded by American foreign policy.

I

ATOMIC POWER AND AMERICAN FOREIGN POLICY: PROBLEMS AND POSSIBILITIES

The Nature of the Relationship

The reasons for insisting on the importance of including atomic power as a component of American foreign policy have already been suggested above. Because atomic power provides a new energy source capable of significant and even gigantic socio-economic results, because it offers some answers to important economic problems and aspirations of our major allies as well as of strategically crucial underdeveloped regions, because we are leaders in the atomic energy field as well as the dominant leader of the organized noncommunist world, the potentialities of atomic power must not only be harnessed for peaceful purposes, but in the interest of America's world position and international objectives. If it is important for American foreign policy to contain economic and technical and psychological subpolicies, it is also equally important that there now be added an atomic power facet to our governmentally directed relations with the world.

The justifications for incorporating this new energy source into our foreign policy lead quite logically to some general considerations pertaining to the nature of the role which such a technological development can play. What, in other words, are the requirements for any sound union of atomic power and foreign policy? Much of the answer to this highly important question is to be found in a brief consideration of the basic characteristics of this new force.

To begin with, we must recognize atomic power for what it is in the field of human endeavor: a form of energy which can be employed to generate electricity and, thereby, operate machinery. As such, it has significant potentialities both for industrialism (power and propulsion) and for agriculture (purifying and then pumping irrigation water, and manufacturing fertilizer). The fact, as we know, that such power can be obtained from small quantities of fissionable material, instead of the presently required huge amounts of fossil fuels or falling water, gives it an exceedingly important mobility. From the perspective of foreign policy, however, these basic features of atomic power clearly designate its role as that of an instrumentality, a policy weapon which bridges the economic and technological facets of human affairs. As such, this non-military cousin of the atomic bomb and artillery shell must be incorporated into American foreign economic and technical policy

in just the same way that its explosive relatives have been integrated into national military policy. It is not, in other words, a substitute for any present component in our foreign policy so much as a new dimension which will have conditioning impact on already established programs but will not replace them. Given this fact, any real insight into the nature of atomic power's international role requires some review of the basic objectives of contemporary policy and, particularly, of its economic and technological components.

The foundation of American foreign policy, like the substructure for that of any other nation-state, must be the promotion of national survival, material well-being, and freedom. As a democratic nation-state, America, in its foreign policy, must necessarily interpret these primary goals in terms of the security, well-being, and liberty of the society—of the people—rather than of the government and state. For, quite obviously, the promotion of the greater good and glory of the state can no more characterize democratic foreign than domestic policy. In addition, democracy requires that our policy also be responsive to the moral and ideological aspirations of our society. Since the fundamental goals do no more than chart the broadest of outlines for any course of action, however, American foreign policy also is constructed of a number of narrower medium and short-term objectives intended to give specific content to the national definition of self-interest and self-development. It is these more limited policy objectives—as distinguished from the fundamental goals —which must necessarily be formulated and re-formulated to take into account those major changes in domestic and international conditions which the dynamic quality of human society invariably and unceasingly fosters.

Since 1945, we have witnessed just such reformulations, for contemporary America has undergone a foreign policy revolution in the last ten years.[1] Not only has the United States firmly assumed that position of great power leadership which it began to achieve in World War I and on which it attempted to turn its back between the two world wars, it also has renounced those manifestations of isolationism and neo-isolationism embodied in such previously honored policy guides as "no permanent or entangling alliances," neutrality, and continentalism (an exclusive preoccupation with North American development). Though public debate has frequently been entered into during the past decade concerning the possibilities and virtues of a return to our traditional policy perspective, there can be no doubt as to the extent of our official rejection of such a reversion to the past. We are now completely entangled in more international arrangements, alliances, and regional collective security systems than perhaps any other country of history, and, therefore, we are about as deeply immersed in the outside world as is possible within the limits of the nation-state system.

Without engaging in any very elaborate discussion of this new formulation of medium and short-term objectives—all of which are primarily a product of our dis-

[1] See WILLIAM G. CARLETON, THE REVOLUTION IN AMERICAN FOREIGN POLICY (1954) for an excellent summary of that revolution.

illusionment from 1945 to 1947 with the United Nations' ability to maintain international peace and security in the face of Soviet expansionist challenges as well as of our gradual realization that the old order of pre-1939 could not be restored—it would seem valid to state the following to be our current policy aims: to restrain communist expansion while simultaneously attempting to negotiate some realistic settlement of conflicts in interest which threaten human survival; to promote greater international material well-being in behalf of international peace as well as for our own security and prosperity; and to encourage, where feasible, both national self-determination and democratic government as important contributors toward the above two international objectives. Obviously, this particular policy pattern encompasses not merely a narrow pursuit of American self-interest and power, but some of the idealism and humanitarianism which also are significant characteristics of our society. It is, moreover, compounded of even more specific policy objectives, such as the promotion of West European and North Atlantic integration, economic well-being, democratic orientation, and military strength, and the encouragement of political stability, economic welfare, and ties with the West of other noncommunist areas whose strategic location and/or resources make them vital despite their normally underdeveloped characteristics and civilizational differences.

As a part of the above pattern of contemporary American foreign policy, the role of economic and technological policy objectives and techniques becomes that of bolstering this global effort to restrain communism and strengthen and solidify the noncommunist world. For, in the words of the United States Deputy Assistant Secretary of State for Economic Affairs: "An alliance without economic underpinnings would be inadequate and unreliable."[2] The primary forms of technique so far devised to actualize these aims[3] can be classified as technical assistance, financial investment, loans and other forms of economic assistance, tariff reductions, and trade concessions. It is alongside these established techniques that atomic power must now be placed: a new instrument of significant potentialities which cannot be ignored and must, therefore, be utilized in support of the totality of other techniques and objectives which constitute American foreign policy.

Atomic Power's Potentialities for Underdeveloped Lands

Having outlined the character of the American foreign policy setting within which atomic power must be utilized as an economic and technical instrumentality, it becomes particularly pertinent to face up to the specific implications and potentialities for American relations with the world of this great new form of energy. What, in other words, are the effective uses to which it can be put as a policy instrument?

To begin with, it is important to recognize the extent to which any utilization of atomic power is subject to many of the same cultural problems and limitations as

[2] THORSTEN V. KALIJARVI, FOREIGN ECONOMIC POLICY AND THE NATIONAL SECURITY 5 (U. S. Dep't of State Pub. No. 5640, 1954).

[3] For a specification of our foreign economic objectives and their relation to politico-military and psychological policies, see Asher, *The Economics of U. S. Foreign Policy*, 29 DEP'T STATE BULL. 3 (1953).

most other significant technological innovations. For, after all, the application of atomic power does not occur in some huge vacuum devoid of social forces. On the contrary, it is confronted by a complex web of cultural conditions of both ancient and modern origin which vary significantly from one region of the world to another and generate all manner of obstacles to, as well as desires, for, this new energy form. It is, thus, essential to acknowledge the extent to which the international utilization of atomic power is not just a matter of presently limited supply and mounting demand, but also a question of the complex character of the recipient market as well. To assume that the beneficial use of atomic power will occur automatically and that, in the words of Professors Isard and Whitney, "mere availability of atomic power at a relatively low cost will somehow produce the cornucopia of plenty even for the most backward regions of the earth"[4] is to ignore completely the extent to which the introduction of any technological development of this type is dependent upon "the degree of legitimacy such an innovation possesses in relation to the cultural norms of the area."[5] As an important recent publication of the United Nations Educational, Scientific, and Cultural Organization points out, technical changes embodying possibilities for great human benefit often encounter all manner of cultural obstacles and resistances generated by important local customs, modes of life, and values.[6] Some peoples, it is noted, for example, have a "distaste for working for wages" which often is stronger than the "incentive to improve the standard of living" (Puerto Ricans, Spanish-Americans of New Mexico, and some Africans are listed by the UNESCO study);[7] in "many parts of the world we find that one works as necessity calls,"[8] while in other lands, like Burma, there exists a strong resistance "against the accumulation of capital" combined with "the tendency to spend much money for religious purposes" which "militate against the creation of capital needed for industrial enterprise of any major scope."[9]

Such examples of cultural impediments to any form of technical change, including a power innovation of the type under consideration, can be elaborated upon endlessly. One does not even have to leave the industrialized Western world itself to find evidences of the way in which cultural resistances have limited the acceptability of primary techniques and tenets of modern technology to the point where peoples desirous of the benefits which they know are available have themselves participated in their restriction. This is the case, for example, of France, whose rugged individualism and family-type business enterprise combine to prevent full tapping of mass production's rewards and have led to a deterioration of what was at one time the highest standard of living on the European continent. Such has been true to an even greater extent in Italy. As the above-mentioned UNESCO study asserts, it thus

[4] WALTER ISARD AND VINCENT WHITNEY, ATOMIC POWER 140-41 (1952).
[5] *Id.* at 138.
[6] WORLD FEDERATION FOR MENTAL HEALTH, CULTURAL PATTERNS AND TECHNICAL CHANGE 236-42 (Margaret Mead ed. 1953).
[7] *Id.* at 244.
[8] *Id.* at 247.
[9] *Id.* at 246.

"seems painfully evident that the most miserable living conditions (from the viewpoint of the industrial nations) do not of themselves make technical improvements acceptable, nor make disruption and maladjustment less likely once change is introduced."[10] The attainment of economic and technological improvement throughout the world, therefore, obviously cannot be accomplished merely by making available a new power source as complex and with as many ramifications as atomic power. Fissionable material and nuclear reactors cannot just be handed over to non-Western societies with the expectation that gigantic benefits automatically will accrue regardless of the cultural setting.

Unfortunately, the American foreign policy—and international—problem of effectively utilizing the atom in power-deficient areas is not limited to meeting and surmounting various cultural resistances and sociological obstacles. There are, in addition, a wide variety of other complicated social, political, economic, and financial conditions which are crucial determinants of the feasibility and possible effectiveness of atomic power's contribution to a given country's well-being. We find that just about all existing investigations into the problems of presently underdeveloped regions conclude that most of the latter's destitution and material inadequacy is traceable to situations other than the absence of an adequate supply of fuel for power, though such is often a significant handicap. There appears to be general agreement among the authorities on international economic development that, for one thing, the primary requirement for improvement in a country's material well-being is capital available for investment. In their pioneering study of the *Economic Aspects of Atomic Power,* Messrs. Schurr and Marschak thus conclude, for example, that[11]

> . . . the chief limit upon the possible rate of industrialization in most backward areas appears to be the scarcity of capital. This is particularly significant since it is only by means of a rather rapid industrialization that these countries can hope to escape the pressure of a growing population against limited agricultural resources.

Such scarcity of capital, it should be noted, is both a domestic and an international one. Within the underdeveloped countries, the essential developmental capital is unavailable because "the sheer poverty of the bulk of the population is such that the flow of savings is a mere trickle."[12] Therefore, any "launching of a process of cumulative economic growth . . . requires an expansion of the rate of capital accumulation in those countries to something on the order of three times the present level."[13] With an estimated capacity to provide no more than "about half of the needed increase in net investment,"[14] however, the obtainment of foreign loans or grants to the extent of about 50 per cent of the needed investment

[10] *Id.* at 276.

[11] SAM H. SCHURR AND JACOB MARSCHAK, ECONOMIC ASPECTS OF ATOMIC POWER 273 (1950).

[12] Higgins and Malenbaum, *Financing Economic Development,* 502 INTERNATIONAL CONCILIATION 279 (1955).

[13] *Id.* at 313.

[14] *Ibid.*

capital is indispensable, it is estimated. But the attraction of these sizable foreign funds is extremely difficult both because of the investment requirements of the great industrial states themselves and because of the hesitancies of foreign investors. Underdeveloped countries, therefore, face a situation in which the foreign exchange needed is in just as scarce supply as domestic investment capital.[15] Yet, it is this very investment which provides the means not only for economic development in general, but for the creation of power facilities—atomic or otherwise. In connection with the latter, moreover, though atomic power may provide savings in capital through reduced transportation costs for fuel and perhaps even through reduced fuel costs, the size of the capital investment in the construction of atomic power reactors is much greater than that of traditional installations, while capital requirements for the creation of the standard distributory facilities remain the same.

The importance of investment to economic development is just one factor in the problem of raising material well-being throughout the world. Another major element, which is characteristic of most underdeveloped areas, is excessive population. The initial impact of industrialization increases the size of a populace. Thus, unless such industrialization occurs at a rate in excess of the demographic growth, the introduction of atomic power would not produce much improvement. Inadequate domestic markets, continued low standard of living, and insufficient capital accumulation would continue.[16]

Still other major obstacles to economic development in presently underdeveloped lands include such situations as the absence of middle classes to provide the "entrepreneurship" essential to an industrial revolution; mass demands for state-sponsored welfare and immediate increases in consumer goods upon liberation from colonialism regardless of the detrimental impact on economic development of any premature welfare system; the great absence of not only large enough pools of advanced scientists to operate atomic power installations, but even of laborers with the basic skills required by modern industrialism; the frequent inadequacies of governmental bureaucracies and political leadership and their reluctance to engaged in essential, though radical, changes; the resistance to technological innovation of socio-economic upper classes, whose own material well-being is a product of agrarian feudalism; and widespread chauvinism and antiforeignism (generated by previous colonial experiences), which enhance the unattractiveness of a country to private foreign investors.[17]

[15] See the introduction to the Tenth Annual Report of the U. N. Secretary General, N. Y. Times, Aug. 8, 1955, p. 3, col. 1, for emphasis on the obstacle to economic development presented by the shortage of investment capital.

[16] See Whitney, *Some Sociological Consequences of Atomic Power*, 290 ANNALS 67 (Nov. 1953), for a discussion of this demographic problem.

[17] Argentina provides a case study of anti-foreignism's impact on investment. The country produces 40% of its oil need and spends $200 million a year of scarce dollars to import the rest, despite having ample domestic resources to meet its entire need. But, lacking capital and technical knowledge, the legislature has, none the less, for purely nationalistic reasons, so far, balked at permitting completion of a contract with Standard Oil of California to develop and exploit the untapped oil reserves.

These are some of the primary causes—above and beyond power shortages—of that economic backwardness which American foreign policy recognizes to be a potential hothouse for communism and, thereby, as well as in its own right, a source of great danger to the United States and the West. When one adds an awareness that many presently underdeveloped lands could significantly increase their power output from existing fossil fuels or through increased hydro-electric installations[18] if they could surmount the obstacles noted above, and when one further notes that full-blown industrialization is not automatically essential to material improvement and that some nations, like Australia, New Zealand, and Denmark, have achieved their extremely high living standards "not by domestic production of heavy industrial goods but by trading their specialized agricultural products with the major industrial countries,"[19] the economic need for and usefulness of atomic power in many backward areas is, thus, open to question. At a minimum, it certainly seems apparent that neither American foreign policy nor international opinion would be justified in viewing atomic power as a key to universal utopia.

Despite the difficulties confronting the promotion of material improvement in the underdeveloped portions of the world, either with or without the assistance of atomic power, however, socio-economic, psychological, and political forces within these lands constitute an outstanding contemporary challenge which must be met. There can be no disinterest in the fate of most of Asia, the Middle East, Africa, and Latin America not only because of humanitarian considerations, but also because of the West's material and strategic dependence upon them. Nonetheless, to date, the Western world's greatest failure—and, consequently, communism's greatest success—has been in its response to the "social politics" of these regions. For we have found it extremely difficult to meet effectively the socio-economic, political, and colonial revolution which has shattered the old order and threatens to undermine both the liberty and the well-being of the West. Given this global uprising of previously subordinate, but still vital, regions, we have no choice but to assist them to achieve a large portion of their primary aspirations in ways which will not be detrimental to our own existence and that of our fellow Westerners. Any permanent failure on our part in this regard may be comparable to committing suicide. American and Western self-interest thus demand—at a minimum—that we ride herd on the revolutionary forces rocking most of the earth in order to assure that their fulfillment will not lead to freedom's destruction. To accomplish this, we must placate the psychologically generated insistence on equality and full recognition of their independence and importance, while simultaneously responding to the need which these underdeveloped lands have of us as sources of capital and technology and as stable markets for their primary exports. At the same time, it is equally vital for the West that the underdeveloped lands do not pursue unattainable and mutually unbeneficial forms of industrialism, but are encouraged, instead, to act "as expanding

[18] See SCHURR AND MARSCHAK, *op. cit. supra* note 11, at 262.
[19] ISARD AND WHITNEY, *op. cit. supra* note 4, at 168.

sources of supply of primary products and as growing markets for [Western] manufactured goods."[20] Though important Western-underdeveloped area differences of economic interest do exist, and are accentuated both by the latter's social-psychologically motivated attitudes toward imperialism and nationalism and by the former's frequent longing for a return to the days of world submissiveness to the West, the challenge to both becomes the development of the means of harmonization of such conflict to the advantage of all.

Atomic power may help to promote this necessary harmonization, even if it is not capable of producing instantaneous and gigantic improvements in material conditions throughout the entire world. To those lands which are anxious to harness the atom, the United States and its technologically advanced partners can make available the scientific information, industrial know-how, fissionable materials, and even model reactors to help them to do so. The fact that some underdeveloped lands will not be interested in atomic power, that many others may be interested in it primarily from motivations of nationalism and prestige rather than from need or ability to utilize it effectively, and that, probably, only a minority of the noncommunist underdeveloped nations of the world really are in a position to employ atomic power effectively in the near future should not prevent the formulation of an American and Western atomic power foreign policy. For, it is just as important for the United States and its industrial allies to respond to any officially expressed interest in atomic power by governments of lands motivated by nationalism and prestige politics as it is to help the lesser number whose justifications would really be economic. It is, after all, only by placating the psychological as well as the material drives of newly freed peoples that we can convince them of our good intentions and of the mutuality of interest which exists between them and the American-led West. What is, thus, necessary for American foreign policy is a flexible use of atomic power, not merely as an economic weapon to improve the standards of living of noncommunist states, but also as a symbol of Western understanding of other peoples and sympathy for their aspirations.

The question then arises as to whether atomic power assistance to underdeveloped lands should be handled exclusively in bilateral terms or not. Should the United States and other prospective providers of such aid, like the British and French, engage in uncoordinated and independent distribution of it as each sees fit, and should such atomic power assistance be completely separate from the United Nations' technical assistance activities? Several thoughts suggest themselves in connection with this important matter. The first is that, at a minimum, an atomic power aid program for the underdeveloped areas of the world must involve a collaborative effort by the Western contributors. This makes sense not only because the latter have a great identity of security and economic requirements in relations with the underdeveloped lands, but also because collaborative effort among them can bolster the

[20] WILLIAM Y. ELLIOTT (ED.), THE POLITICAL ECONOMY OF AMERICAN FOREIGN POLICY 326-27 (1955); and see also, generally, for an excellent discussion of foreign economic policy.

effectiveness of their aid programs. Completely independent action, on the other hand, will introduce an unhealthy national competition destructive of their common and national interests. It would, for example, be ridiculous for the United States, British, and French Governments to engage exclusively in uncoordinated and competitive aid programs, since their real and common competitor for the favor of the underdeveloped regions obviously is Chinese and Soviet communism. In many instances, the most that would be achieved would be for each to undermine the leadership position of the other in areas vital to each as well as to the whole Western cause. The importance of Western cooperation in the peacetime—as in the military—applications of atomic power thus seems essential. Such cooperation probably requires the creation of a coordinating agency among the Western powers which would, in turn, be linked to other still unborn regional economic agencies also vital to the promotion of material well-being throughout the area.

The problem of coordinating Western atomic power foreign policies is more than just a matter of governmental recognition of the political benefits to be derived from so doing, however. For, the field of atomic power also offers very important commercial opportunities for private enterprise. Both American and British firms, in particular, are presently organizing for the purpose of exporting nuclear equipment and technical assistance. The atomic power displays at the Geneva Conference in August 1955 and the vocalized resentment of American businessmen at the greater British preparation for atomic power commerce revealed at that Conference clearly demonstrated the competitive struggle which is in the offing. Undoubtedly, in the future, French and German and possibly other European interests will also enter the struggle for a share of this new export market. It, thus, would appear important that governmental recognition of the pending private international competition be taken in the form of a multilateral effort to develop some agreement which would protect mutual national interests, while yet not frustrating healthy private commercial activity. Guides to such an intergovernmental agreement might possibly be found in comparable and established areas, like petroleum, standard electric power and generation equipment, or even in a field like air transportation. In any event, this would seem to be a problem for American and Western policy whose solution will be extremely important to the successful employment of atomic power as a constructive foreign policy instrument. The pursuit of private and national interests must be coordinated.

In so far as the relationship between Western national atomic foreign policy and the United Nations is concerned, it would appear necessary that at least some—if not a major portion of—atomic power assistance to backward areas be channeled through that organization. The reasons for this include the Western interest in maintaining the United Nations as a force in international relations, even if it cannot be converted into a world government; the fact that the United Nations has done its best work in the social and economic fields where great-power security rivalry is less of an impediment; the additional fact that some means of coordinating

Western with communist efforts in the area of peacetime utilization of atomic energy is vital both for the peace and material improvement of the world and to make clear to the world the peaceful objectives of the West; and, finally, the fact that the United Nations can provide existing and planned technical assistance agencies which are much less provocative to those anti-foreign and anti-colonial sensitivities now rampant in many underdeveloped lands than would be the national assistance agencies of the Western powers. This is particularly pertinent in the field of atomic power development, since the exporters of atomic power plants may have to operate and maintain them until local personnel is trained and may also continue indefinitely as the primary suppliers of fissionable fuels. Moreover, utilization of the United Nations for atomic power development in underdeveloped lands might also be a means of overcoming such important obstacles as the lack of adequate investment capital, a bad international balance of payments situation, and the absence of adequate numbers of skilled scientists and technicians to man nuclear power installations and train increased numbers of their fellow countrymen. For, with the support of the leading nuclear power nations, a United Nations Atomic Energy Agency could conceivably provide interested countries not only with information and assistance in atomic power research and engineering, but could also help to train atomic power scientists and technicians in underdeveloped lands, act as an allocator and transmitter of fissionable materials to needy states, and even perform the vital role of financier of atomic power development where inadequate sums of investment capital are available from private international investment and existing international banking and development funds. Furthermore, it is even possible that the same United Nations agency could contract with private firms for the construction of, and then itself operate, nuclear power plants in underdeveloped countries, with the resultant power being sold at established rates to the benefiting nation. This particular technique would save underdeveloped countries the very difficult and expensive task of manufacturing their own atomic power and, thereby, speed up significantly their utilization of this new energy source. It would also help to assure that nuclear reactors in such lands would be employed exclusively for peaceful purposes. It, thus, seems that an effort to integrate Western atomic power foreign policy with United Nations activity in the field is also extremely important, though the exact nature of the integration must naturally depend on East-West relations in the future and the extent to which nationalism among Western politicians can be tempered to the point of willingness to divert some funds and specialists to United Nations agencies.

Atomic Power's Potentialities for Industrial Lands

A consideration of the many obstacles and deterrents to effective utilization of atomic power in the underdeveloped lands serves to emphasize the likelihood that it will be the already industrialized states—with their sustained leadership interest, social receptivity, and technological ability—which will benefit from nuclear fission earliest and possibly even the most. Among these industrialized states, however,

existing differentials, comparable to those which prevail between them and the backward areas, will often affect the utility and impact of atomic power. Thus, partially industrialized nations which, to date, have been unable to heighten either their level of industrialization or their standard of living for reasons other than just inadequate fuel resources will not suddenly be able to erect utopias with nuclear reactors. Italy, for example, is a case in point in this regard. Though energy resources are in tremendous short supply, this difficulty is compounded considerably by the lack of adequate investment capital, by the retarded views of her dominant socio-economic upper classes with their agrarian feudalistic or monopolistic industrial beliefs, and by inadequate governmental leadership for economic development. When these characteristics are combined with the nation's lack of important minerals and its weak agricultural structure, it is obvious that the availability of atomic power will not, by itself, put an end to all Italian material distress. It may, in fact, make Italy's existence in the world more difficult by enabling already stronger competitors to increase their advantage with a resultant further deterioration of the traditionally unfavorable Italian balance of trade.

In other cases, like that of the French, the application of atomic power undoubtedly will benefit the country considerably by relieving the ever greater pressure on its inadequate coal and oil resources. However, here, too, it probably is not to be expected that the net French gain in the world economy will be startling. It is very possible that France will increase her industrialization and standard of living through use of the atom, but no catching up to Britain or the United States can be expected. As for the last two nations, though the British go over almost completely to atomic power decades before we do, while the United States continues to rely mainly on its still ample fossil fuels, no equalization of British and American industrial might is to be expected.

As for the Soviets, the fact that their scientists have indicated at Geneva that they will employ atomic power primarily in areas presently remote from traditional fuels does not mean that they will not benefit significantly nor does it mean that they will fall farther behind in industrial competition with the West. On the contrary, limited but strategic use of atomic power in a country as poor in transport but as rich in minerals as the Soviets probably will help their industrialization tremendously. It, therefore, seems important to emphasize the fact that not even those nations which benefit earliest and perhaps most from atomic power will do so to the same extent or in such fashion that their economic strength will be equalized. On the other hand, they undoubtedly will increase their edge over most presently underdeveloped lands, at least for the foreseeable future.

Any survey of already existing atomic power development programs documents the degree to which the already industrialized countries, rather than the neediest ones, will take earliest and greatest advantage of nuclear fission. The British, for example, are currently involved in a ten-year plan to construct twelve nuclear power plants, at an estimated cost of £840 million, in order to meet their steadily di-

minishing coal reserves and increased power needs. For, it is estimated that the United Kingdom, which in 1913 supplied half the world's coal trade from its exports, now must buy a ton of doubly expensive West Virginia coal for every ton of its own which it exports. Moreover, it is increasingly harder to obtain miners, since the youth prefers the more pleasant occupational opportunities available in this labor-short economy. At the same time that such severe shortages are being felt, official estimates are that demand for electricity probably will be three and a half times the present level in twenty years and that this obviously will require an impossibly high consumption of coal.[21] The total capacity of the twelve atomic stations planned, therefore, will be from one and a half to two million kilowatts, while their consumption of fuel will be 500 to 600 tons of fissionable material per year, instead of 5 or 6 million tons of coal. The cost of the resultant electricity will be about 7 mills per kilowatt hour, or about the same cost as coal burning installations. Thus, the British development program is expected to permit a leveling off of the demand for coal in the 1960's and a steady increase of nuclear power station capacity after 1965 until, by 1975, the latter will produce 10 to 15 million kilowatts, or a fourth of the nation's total electric power, while by the year 2000, atomic power will provide most British electricity. The United Kingdom's ability to launch this presently most ambitious of atomic power undertakings is, of course, directly related not only to the seriousness of its motivation, but also to its current degree of industrialization, the availability of investment capital, the existence of all necessary distribution facilities and of the scientific and technological skills required, and the great governmental capacity to direct and energize a program of this type.

On an understandably smaller scale, the French Government is also engaged in a major effort to alleviate its country's steadily diminishing coal supplies and heightened dependence upon the import of fuel by resort to atomic power development. The French, thus, plan to build a 40,000 kilowatt power reactor in the near future to produce plutonium which, in turn, will be fed to other reactors. They have indicated that all attention will henceforth be devoted to such atomic power development, while their large hydro-electric development program and efforts to harness the tides will be restricted. France now has two important experimental reactors in operation and so is able to trade on this know-how plus financial and industrial resources which, though inferior to those of the United States and Britain, nonetheless remain adequate to meet the challenge of atomic energy. Still other examples of West European progress in the field are afforded by the Norwegian concentration on atomic power for ship propulsion—which obviously is related to the country's role as one of the great maritime nations of the world—as well as by the Dutch, Belgian, and Swedish experiments and preparations for atomically generated electricity. Thus, though it is true that one finds comparable interest and even some experimentation and planning for the utilization of atomic power outside of

[21] See the White Paper, *A Programme of Nuclear Power*, CMD. No. 9389 (1955) (available through the British Information Services).

the West or the Soviet Union—as in the cases of India and Israel—the possibility of early important applications of this power, even in these underdeveloped lands, certainly is nowhere as impressive as in the North Atlantic community.

The advanced character of Western activity and planning in the atomic power field makes particularly pertinent the question as to the proper American role in all of this and the direction which American atomic power foreign policy should take within the Western community. Certainly, a policy other than that pursued toward the non-Western world is required not merely by the differences in our relationship to each, but by the divergencies in atomic power potentiality already noted for each area.

To begin with, it is important to return to the emphasis placed at the outset of this article on the necessity of integrating atomic power policy with that of our general economic and technical foreign policy objectives. In the case of Western Europe, these objectives involve the promotion of regional integration as an essential condition of further European economic progress, political stability, and security. They also include concern for expansion of the region's industrial strength as a crucial ingredient in the furthering of our own political and strategic interest in preserving West Europe's freedom from communism. An analysis of the primary economic difficulties of the Western European industrial states reveals, however, that more is needed than American loans, gifts, and technical assistance in order to promote the necessary plant modernization and expansion and increased trade within the area, though such aid helps considerably. As a recent authoritative analysis emphasizes, Western Europe also requires "closer economic integration with North America."[22] Within the limits of American international authority and domestic obstacles, therefore, our economic foreign policy response to Europe's needs must take the course of reducing our own tariffs while simultaneously condoning a certain amount of European protectionism against American competition; of fostering adequate economic demand and stability within the American economy; of assisting domestic producers to adjust to larger imports of European products; of expanding "offshore procurement" and other such means by which Europeans can earn dollars outside the American domestic market; and of engaging in closer institutionalized economic integration with the North Atlantic community members in addition to the military integration represented by NATO.[23] Simultaneously, of course, we and the West European industrial nations must also attempt to achieve that compromising and harmonization of economic interest with the noncommunist underdeveloped lands which will provide satisfaction for the latter's aspirations for material improvement and freedom while still encouraging them to meet basic Western needs for raw materials and for manufactured goods' markets.

Within these over-all policy requirements, the United States can employ its leadership position in nuclear energy to great avail. Since Western Europe probably

[22] ELLIOTT, *op. cit. supra* note 20, at 290-91.

[23] See *id.* at 295-325 for an excellent discussion of such techniques.

will be the most immediate and most important beneficiary of atomic power in the foreseeable future, American policy must facilitate to the maximum extent possible the ability of the region to tap the industrial atom. This obviously is in our own interest—given the interdependence of Europe and ourselves—as well as in that of our allies. Several components of such an atomic power policy toward the North Atlantic community and its industrial allies elsewhere can be suggested. First, since most of these countries already have varying degrees of atomic power development underway, one important form of assistance can be provided merely by making available necessary information of a scientific and technological character. For, as a trained American observer of Europe's atomic power activities has recently remarked, what is desired from us is "mainly detailed technical knowledge" to enable their highly skilled scientists to speed up their developmental programs and save them unnecessary and fantastically expensive research and testing.[24] Certainly, the dissemination of such informational assistance to our allies serves the interest of the entire Western world and cannot jeopardize our security, since the Soviets are already fully able to utilize atomic power as well as make atomic weapons. Moreover, as many American scientists have also commented, their European counterparts have been engaged in forms of atomic research and have gained types of knowledge for which we have not had the time because of our necessary military preoccupation. Dr. Lawrence R. Hafstad, chief of the AEC's reactor development program, thus has been quoted as saying:[25]

> Contrary to the general impression in this country, the Europeans are very sophisticated in the atomic-energy field. . . . Our reservoir of facts is almost dry, and the Europeans have all the technical and scientific knowledge they need to make progress.

Thus, there will be value received from any exchange of information; and an American program of atomic power informational exchange with Western Europe will involve just that: a mutually beneficial exchange rather than a mere unilateral distribution of knowledge.

A second important ingredient in a meaningful American atomic power policy toward our industrial allies would seem to be the lending by us, where requested, of processed fissionable fuel for power. This would speed up Europe's ability to apply atomic power by reducing the necessity to obtain and then process fissionable material at gigantic cost. Though such aid is probably advisable only in the early stages of atomic power development, its stimulative impact can be great. Moreover, in some cases, it could be related to agreements by the recipients to make their crude uranium available to us and, thereby, bolster our own sources of supply.[26]

Third, the United States can help these nations to purchase reactor and related equipment from private American firms by somewhat unharnessing interested private enterprise within the limits of our own national security and military needs.

[24] Hughes, *International Cooperation in Nuclear Power*, Scientific American, April 1955, p. 31.
[25] See Newsweek, Nov. 22, 1954, p. 79.
[26] See our agreement with Belgium, discussed below, for example.

In this connection, of course, it is important to note the extent to which the dollar exchange resources of these nations would be strained even more than they now are, and so American tariff restrictions on the ability of European firms to compete in this trade would be extremely unwise. If British companies, for example, can capture an important part of the nuclear reactor market, this should not be deplored and fought by American governmental action but, instead, should be considered a contribution to Western economic health and consonant with United States foreign economic policy objectives.

As was suggested in discussing atomic power relations between Western and underdeveloped states, some form of institutionalized atomic power cooperation within the Western community also is essential. It is vital not only to facilitate Western efforts to resolve the problems in its economic and political relations with these backward lands, but also to assure the obtainment of maximum benefit from atomic power within the West. The arguments in behalf of generally closer North Atlantic community economic integration, thus, are particularly impressive when one considers this important new energy source. Rapid utilization of it by most of our allies requires great American assistance. The fundamental character of atomic power's relationship to industry and its governmental sponsorship in all countries, plus the dependence of our allies on governmentally generated development programs, further accentuates the need for intergovernmental cooperative planning for its use. In addition, the intimate connection between industrially usable atomic power and militarily useful nuclear energy compels governmental involvement in its production for national and NATO security reasons. Thus, all important considerations suggest the necessity for the establishment of some North Atlantic community planning, coordination, and regulatory agency which would treat not only atomic power, but related problems of peacetime application of nuclear energy. For greatest effectiveness, it probably must be linked to increased financial integration within the region. All this should be in addition to American atomic power and nuclear energy activity through the United Nations, whose purpose would be primarily to aid underdeveloped areas and promote cooperation with the communist bloc.

II

ATOMIC POWER AND AMERICAN FOREIGN POLICY: THE RECORD TO DATE

A survey of American foreign policy activity, to date, in regard to atomic power can be organized around two broad categories: the legislative framework for action and the actual international activity proposed or engaged in. In each of these areas, we have made some initial progress toward the formulation of a meaningful foreign policy of the contours suggested above. In just about all aspects of these same areas, however, much still remains to be done if we are really to utilize the atom with maximum effectiveness in world affairs.

The Legislative Framework

The initial legislative foundation for post-war American activity—domestically and internationally—in the atomic energy field was, as we know, the McMahon-sponsored Atomic Energy Act of 1946. Quite understandably, this first effort to regularize those activities—which originally had been prompted by the war-time struggle for survival—perpetuated the preoccupation with the military potentialities of the atom. Post-war disillusionment with United Nations' efforts to establish a firm peace and the appearance of "cold war" between the Soviet and Western members of the victorious coalition certainly did not encourage any other emphasis than that of bomb-making. This military perspective, in turn, fostered stringent limitations on the exchange of nuclear information, goods, or services and glorified secrecy in the hope of maintaining an American monopoly in the nuclear field. Moreover, though the Atomic Energy Commission was permitted by the 1946 statute to develop large-scale experimental power reactors, meaningful private participation in the power field was made impossible through a combination of absolute prohibitions and stringent licensing provisions. With the loss of the American monopoly of the atomic bomb and a mounting need for the United States to bolster and help re-arm its Western allies, a 1951 amendment to the McMahon Act allowed some limited transmission of restricted data to friendly powers concerning source material, reactor development, research development, and the production of special nuclear materials. In the particular matter of industrial applications of atomic energy, however, the McMahon Act remained firmly opposed to the exchange of restricted data with other countries and also prohibited any person from engaging in the production of fissionable material outside the United States. One can, therefore, say, with reasonable accuracy, that the first American legislative effort in the nuclear energy field not only concentrated upon the military aspects of the atom and restricted the international exchange of information to a minimum, but it also prevented any effective private activity in atomic power development and ruled out the possibility of meaningful international atomic power commerce.[27] No wonder, then, that Atomic Energy Commissioner Smyth could testify in hearings to revise the 1946 Act before the Joint Committee on Atomic Energy of the Congress that, as of June 1954, the American Government itself had spent less than one-tenth of a total expenditure of $10 billion on the nonmilitary aspects of nuclear energy or on research facilities. Almost all of the funds and energy of the government, operating in a monopolistic position which barred private activity, had thus been devoted to the military atom.

By 1954, however, a number of things had occurred which made obvious the need for statutory changes which would facilitate both atomic power development and a more positive American nuclear energy program in international affairs. For one thing, pressures from interested portions of American industry had been building up, and had been stimulated by the AEC's "industrial participation program."

[27] See HERBERT S. MARKS AND GEORGE F. TROWBRIDGE, FRAMEWORK FOR ATOMIC INDUSTRY 61 (1955).

The latter had been launched in 1951 by the AEC in cooperation with four industrial groups anxious to investigate the economic feasibility of atomic power. Composed initially of eight electric utility and chemical companies, these private groups expanded steadily as the industrial potentialities of the atom became increasingly apparent. Another pressure in behalf of revision of the 1946 act was generated by the public itself. What information was released concerning possible peacetime uses of nuclear energy was sufficiently challenging to capture the imaginations of even the most unscientific portions of the citizenry. Finally, President Eisenhower provided official support for a liberalized statute when, on February 17, 1954, he recommended to the Congress that it amend the McMahon Act for three important reasons: to permit "widened cooperation with our allies," "improved procedures" for the treatment of nuclear information, and "broadened participation in the development of peacetime uses of atomic energy."[28] The ultimate result of this combination of private and presidential pressure was the present Atomic Energy Act of 1954.

Since the presidential initiative in urging Congress to amend our atomic energy legislation resulted primarily from his desire to foster international governmental cooperation in the field, a significant portion of the subsequent changes embodied in the 1954 statute concerned themselves with these aspects of nuclear energy. Focusing just on the question of the existing legislation's adequacy as a statutory framework for an effective American atomic power foreign policy, the following observations seem relevant:

(1) The act enables the United States Government to conduct an atomic power foreign policy with reasonable effectiveness only in certain respects, which, ultimately, may not be the most important ones. The content limitations on such a foreign policy stem primarily from the new emphasis, on the one hand, on private international atomic power commerce, while, simultaneously, such private international activity appears to be either excessively restricted or in need of additional legal clarification. Thus, we find that the Atomic Energy Act of 1954 authorizes the Government in the person of the President to enter into "international arrangements" with any group of nations interested in cooperation in the nonmilitary applications of atomic energy;[29] permits the Chief Executive to negotiate bilateral "agreements of cooperation" with other individual countries in order to transmit information and materials in some carefully defined areas of restricted data;[30] allows the AEC to make a foreign distribution of certain specified nuclear materials;[31] and also authorizes the President to permit the AEC or Defense Department to communicate other types of restricted data to foreign nations.[32] However, the law, as an effort to promote American private enterprise in the nuclear field, is so designed that atomic power

[28] *Atomic Energy Act of 1946—Message from the President of the United States*, 100 CONG. REC. 1921 (1954).

[29] §§11(k), 124, 68 STAT. 922, 940, 42 U.S.C.A. §§2014(k), 2154 (Supp. 1954).

[30] §§11(b), 123, 68 STAT. 922, 940, 42 U.S.C.A. §§2014(b), 2153 (Supp. 1954).

[31] §§54, 64, 82(b), 68 STAT. 931, 933, 935, 42 U.S.C.A. §§2074, 2094, 2112(b) (Supp. 1954).

[32] §144, 68 STAT. 942, 42 U.S.C.A. §2164 (Supp. 1954).

facilities for the utilization or production of special nuclear material, component parts for power production, source materials, and regular technical services will be channeled abroad primarily through business organizations. The act does not even provide specific authorization to the AEC to make a foreign distribution of utilization or production facilities or component parts. Instead, as recent hearings of the Joint Committee noted, "[i]t is contemplated that with respect to the furnishing of equipment, facilities and materials (other than special nuclear materials), U. S. industry will play a major role in implementing agreements for cooperation."[33]

An analysis of the ability of business enterprise to play this export role reveals, though, that a great many legal uncertainties combine with some stringent limitations to make questionable the possibility of full-blown international atomic power commerce. For, each of the principal methods by which business is statutorily authorized to engaged in such commerce is haunted by certain important problems and potential difficulties.[34] Thus, private enterprise can engage in international commerce in by-product[35] and source[36] materials and in component parts of atomic facilities[37] without the existence of intergovernmental agreements, provided licenses are obtained from the AEC. But, in the specific case of component parts, the AEC must also determine in each and every instance if export involves an unreasonable risk to our defense and security. Whether regular and extensive trade on this basis is possible is questionable. Moreover, the ability of business to engage in the manufacture or selling of component parts outside the United States is uncertain, as is the applicability of the licensing technique in these instances.

Another example of potential difficulty for private atomic commerce abroad is provided by the statutory requirement that the production of special nuclear materials and all action related "directly" or 'indirectly" to such production is subject to a special authorization procedure by the AEC.[38] The word "indirectly" raises questions concerning the very ability of private individuals and groups to teach abroad or to provide technical services or parts of facilities, even in unclassified matters, unless they obtain prior Commission authorization. If such specific authorization for activity in unclassified areas is necessary, commerce certainly will be extremely difficult.

Furthermore, one finds that though authorization is obtained, the export of component parts or utilization facilities still must be licensed, and, moreover, neither licensing nor authorization by the AEC can, in itself, permit the export of special

[33] *Hearings before the Joint Committee on Atomic Energy on Development, Growth, and State of the Atomic Energy Industry*, 84th Cong., 1st Sess., pt. 1, at 208 (1955). See also former Joint Committee Chairman Sterling Cole's discussion of congressional interest in the 1954 act, in *The Meaning of the New Atomic Law*, Nucleonics, March 1955, p. 47.

[34] For a full discussion of this matter, see Ruebhausen, *New Atomic Problems*, 9 THE RECORD OF THE ASSOCIATION OF THE BAR OF THE CITY OF NEW YORK 368 (1954).

[35] §82(c), 68 STAT. 935, 42 U.S.C.A. §2112(c) (Supp. 1954).

[36] §62, 68 STAT. 932, 42 U.S.C.A. §2092 (Supp. 1954).

[37] §109, 68 STAT. 939, 42 U.S.C.A. §2139 (Supp. 1954).

[38] §57(a)(3), 68 STAT. 932, 42 U.S.C.A. §2077(a)(3) (Supp. 1954).

nuclear material, complete production and utilization facilities, or certain restricted data. International traffic in these items depends upon an intergovernmental agreement or some regional defense arrangement.[39] Where private commerce is dependent on these "agreements for cooperation," the very elaborate procedures required by law before the agreements can be completed make any regular flow of this type of trade questionable.

Other problems arise, too, from the whole series of prohibitions on things like the export or import of special nuclear materials,[40] the transfer or receipt of such materials in interstate commerce,[41] and the implied prohibition on private ownership of production facilities abroad, though ownership is permitted within the United States.[42] Finally, the exact relationship between foreign subsidiaries of American business and the home companies, in so far as the legal limitations on atomic power commerce are concerned, is in need of clarification.

In summary, we, thus, find that despite the liberalization of our atomic legislation in behalf of greater international cooperation and private atomic energy commerce, the amount of data still classified and the elaborateness of statutory restrictions and prohibitions on private activity combine with the many uncertainties in need of clarification to act as major deterrents to any effective American atomic power development program abroad. Though some clarification, interpretation, and declassification of information has been forthcoming from the AEC recently and licensing techniques are being formulated in cooperation with interested American business, the need for additional liberalizing legislation remains.

(2) A second outstanding characteristic of our existing nuclear legislation, as it relates to the conduct of an atomic power foreign policy, is the unusual extent to which Congress and an independent regulatory agency (the AEC) participate in imposing significant limitations on the President's traditional position in foreign policy. This evidence of legislative distrust of the presidency in foreign affairs—and a partial application of the Bricker amendment mentality—raises some question concerning the effectiveness of American governmental organization to formulate and conduct atomic power foreign policy.

To begin with, the 1954 act states that[43]

> The President is authorized to enter into an international arrangement with a group of nations providing for international cooperation in the nonmilitary applications of atomic energy and he may, thereafter, cooperate with that group of nations . . .

provided that this action is in accord with various specified procedures. This provision was Congress' response to Mr. Eisenhower's proposal before the United Nations General Assembly, on December 8, 1953, that some international atomic pool

[39] §123, 68 STAT. 940, 42 U.S.C.A. §2153 (Supp. 1954).
[40] §57(a)(2), 68 STAT. 932, 42 U.S.C.A. §2077 (a)(2) (Supp. 1954).
[41] *Ibid.*
[42] See §§41(a)(2), 103(d), 104(d), 68 STAT. 928, 936, 937, 42 U.S.C.A. §§2061 (a)(2), 2133(d), 2134(d) (Supp. 1954).
[43] §124, 68 STAT. 940, 42 U.S.C.A. §2154 (Supp. 1954).

plan be established. The interesting thing, however, is that the Congress saw fit to *authorize* the President to negotiate such an arrangement; that it stipulated that the arrangement could be either in the form of a treaty or of an executive agreement which must receive the approval of both Houses of Congress; and that the implementation of these arrangements had to be through intergovernmental "agreements for cooperation," which, in turn, are hemmed in by elaborate procedural requirements, including provisions for congressional review and the need to obtain evaluative recommendations by either the AEC or the Defense Department. For one thing, congressional authorization of the President's right to negotiate these arrangements might be labeled presumptuous, since his authority for such foreign policy action stems directly from the Constitution itself. For another, the statutory requirement that an executive agreement receive the approval of both Houses of Congress certainly is a novel limitation on an important presidential foreign policy power which traditionally has not been so limited. Moreover, the additional requirement that executive agreements be implemented only through "agreements for cooperation" with their elaborate procedural restrictions and their legislative definition of proper content areas surely produces an important restriction on the Chief Executive's ability to perform his constitutional role as chief diplomat.

The Atomic Energy Act of 1954 makes "agreements for cooperation" the crucial instrumentality in the conduct of an atomic power foreign policy. Designed to function on a bilateral basis, in contrast to the multilateral "international arrangements," they are both essential to the implementation of the latter and the only legal basis for much private international atomic power commerce as well as the primary means through which the President can provide other countries with American atomic power assistance. Essentially, such agreements are just traditional executive agreements with elaborate and novel legislative strings attached, both content and procedure-wise. In the case of the former, proper subjects for an "agreement for cooperation" are designated throughout the act in discussions of nuclear materials, facilities, and information. The procedural limitations, are the most unusual, however. As Representative Cole has summarized them,[44] the first stage involves the submission to the President of the negotiated agreement, which must not only meet statutory requirements by specifying its terms, conditions, duration, and scope, but must also contain guarantees by the foreign government to maintain specified security standards, to transfer only that material in accord with the agreement which will not be used militarily, and to transfer no material or restricted data to unauthorized persons except as specified in the agreement.[45] Together with this proposed agreement, the President must be provided by either the AEC or the Defense Department, as the case may be, with a positive or negative recommendation on it.[46] The third stage in the processing of this uniquely limited executive agreement in-

[44] See note 33 *supra*.
[45] §123(a), 68 STAT. 940, 42 U.S.C.A. §2153(a) (Supp. 1954).
[46] *Ibid.*

volves the making of a written presidential determination that the agreement in question will promote American defense and security without engaging in any unreasonable risk. The President is statutorily required to file this assurance after receiving and considering the recommendation of the AEC or Defense Department, to which, however, he is no longer compelled to adhere as he was under the McMahon Act.[47] These three steps having been taken, the President must then return all papers to the Joint Committee so that they are available to it for thirty days while Congress is in session.[48] Though the Joint Committee has no veto power to exercise, if it decides to oppose the agreement, it can then attempt to persuade the various proposers to reverse their positions, or resort to public criticism of the agreement on the floor of Congress, or introduce legislation to prevent the agreement's consummation, or attach riders to other legislation to prevent the agreement from being executed effectively.

The entire process for effectuating international "agreements for cooperation" is, as Representatives Holifield and Durham forced Secretary of State Dulles to admit during Joint Committee Hearings to amend the 1946 act during June of 1954, questionable constitutional practice.[49] The same may also be said of the need for congressional approval of "international arrangements," which, as Senator Anderson noted during those same Hearings, reflects the essence of the defeated Bricker amendment "in that it provides that executive agreements in the international area which deal with atomic matters are not binding unless approved by a majority of both Houses."[50] Quite interestingly, Mr. Dulles actually agreed that this process to which he was consenting was "not drastically different" from the Bricker amendment on executive agreements, as Senator Anderson phrased the situation.[51] Thus, we find that, through such devices as the congressional ratification of "international arrangements," the thirty day proviso, the provision for evaluative recommendations on executive agreements by a subordinate department of the executive branch or by an independent regulatory agency, and the general tone of distrust of the President in foreign affairs, our existing atomic energy legislation serves as a good case study of the tendency during the last few years for Congress to challenge and even attempt to usurp executive authority. It may well be that, in this particular instance in which some unusual congressional success has been recorded, the President may find it necessary to request a liberalization of the statute in order for him to be able to conduct a fully effective atomic power policy abroad.

American Atomic Power Proposals and Actions in International Affairs

To date, the United States has acted on two broad fronts in international atomic politics: the multinational and the bilateral. The major initiative in

[47] §123(b), 68 STAT. 940, 42 U.S.C.A. §2153(b) (Supp. 1954); *cf.* Atomic Energy Act of 1946, §10(a)(3)(4), 60 STAT. 766, 42 U.S.C. §1810(a)(3)(4) (1946).

[48] §123(c), 68 STAT. 940, 42 U.S.C.A. §2153(c) (Supp. 1954).

[49] See *Hearings before the Joint Committee on Atomic Energy on S. 3323 and H.R. 8862, to amend the Atomic Energy Act of 1946*, 83d Cong., 2d Sess., pt. 2, at 691-92 (1954).

[50] *Id.* at 700-01.

[51] *Id.* at 701.

launching an atomic power foreign policy was taken by President Eisenhower in an address to the General Assembly of the United Nations on December 8, 1953.[52] Having just returned from a meeting of the Western Big Three at Bermuda, in which they tackled the problem of coordinating policies in preparation for some effort to reach a settlement with the Soviet Union, Mr. Eisenhower sought to offer the world specific hope that nuclear power could be employed for something better than destruction. After summarizing the developments which launched the atomic age and asserting his refusal "to confirm the hopeless finality of a belief that two atomic colossi are doomed malevolently to eye each other indefinitely across a trembling world . . . ," the President then dramatically announced a series of proposals to reverse "the fearful trend of atomic military build-up" by taking "this weapon out of the hands of the soldiers" and putting it "into the hands of those who will know how to strip its military casing and adapt it to the arts of peace." The essence of his proposal to this world forum was that the[53]

> . . . governments principally involved, to the extent permitted by elementary prudence . . . begin now and continue to make joint contributions from their stockpiles of normal uranium and fissionable materials to an international atomic energy agency . . . [which] would be set up under the aegis of the United Nations.

The ratios of contributions of fissionable material, he stated, as well as the procedures and details of such an agency could be determined by private conversations among the interested parties of which "the Soviet Union must, of course, be one."[54] To this proposed international atomic energy agency, Mr. Eisenhower suggested, could be assigned responsibility "for the impounding, storage and protection of the contributed fissionable and other material . . ." so that the "bank" would be "immune to surprise seizure."[55] Even more importantly, such an agency could also be assigned the responsibility[56]

> . . . to devise methods whereby this fissionable material would be allocated to serve the peaceful pursuits of mankind. Experts would be mobilized to apply atomic energy to the needs of agriculture, medicine and other peaceful activities. A special purpose would be to provide abundant electrical energy in the power-starved areas of the world. Thus the contributing powers would be dedicating some of their strength to serve the needs rather than the fears of mankind.

The world-wide reaction to Mr. Eisenhower's initiative was such as to justify completely the creation of an American atomic power foreign policy. For, the universal enthusiasm accorded the statement demonstrated not only the global interest in the benefits which could be derived from nuclear energy, but the importance to the American leadership position of assuming the initiative in this area. The President's proposal became a primary consideration at the Ninth General Assembly of

[52] *Atomic Power for Peace*, U.N. GENERAL ASSEMBLY OFF. REC., 8th Sess., Plenary 470 (1953), reprinted in *Hearings*, *supra* note 49, at 4-8.
[53] *Id.* at 6, 7.
[54] *Id.* at 8.
[55] *Id.* at 7.
[56] *Id.* at 7-8.

the United Nations, which commenced in September 1954, and it resulted in the unanimous adoption by that Assembly of a resolution in favor of energetic international action to promote atomic energy's peaceful potentialities. The resolution recommended, first, the early establishment of an International Atomic Energy Agency along the lines suggested by the American President and, second, urged the convocation, under United Nations auspices, of an international conference to explore the possibilities for cooperative dissemination of information concerning peaceful atomic technology.[57] The opening American atomic foreign policy move, thus, had proved successful.

Unfortunately, however, the initial announcement's reinforcement of our claim to leadership in peace as well as war, which so captured the imagination of all those who hoped for some material improvement in their standard of living, was somewhat tempered during the General Assembly discussions in the fall and winter of 1954. This resulted not only from the inability to obtain meaningful Soviet cooperation to implement the American proposal, but also from the restricted interpretation of the proposal's scope applied by the United States itself. For, it soon became apparent that the International Agency really represented no more than a small beginning rather than a full-blown international atomic energy program for peace. What the United States really was suggesting was no more than a type of clearing house for nuclear assistance requests, with much of the energy-giving fissionable material as well as most of the vital related technical and economic developmental assistance to be provided through bilateral negotiations, if at all. The original supranational implications of President Eisenhower's speech apparently were not to be implemented. In addition, the power-hungry underdeveloped countries—though ultimately to be represented on the Agency's executive board—were to be excluded from the "private negotiations" to create the organization. These discussions were to be conducted by just the eight states with major technological and/or raw material resources; namely, the United States, Britain, Canada, France, Australia, Belgium, South Africa, and Portugal plus, if it so desired, the Soviet Union.[58]

The result of such revelations during the 1954 General Assembly session was to take much of the original edge off the enthusiasm of most of the UN members who were, in the words of Ecuador's spokesman, being treated like poor relatives.[59] With almost all of Africa as well as all of Asia and Latin America to be unrepresented in the establishment of the Agency, and these areas already dominated by a great deal of anti-colonial suspicion of the West, India and Burma, thus, were merely voicing the views of most of the potential beneficiaries of the plan when their delegates emphasized that the fulfillment of the nuclear promise not only appeared to be substantively limited, but smacked of nuclear imperialism.[60]

[57] U.N. GENERAL ASSEMBLY OFF. REC., 9th Sess., Supp. No. 21 (Doc. No. A/2890) 810(IX) (1954).
[58] U.N. GENERAL ASSEMBLY OFF. REC., 9th Sess., Agenda Item No. 67, First Committee, 707-724th meeting, Nov. 5-Nov. 22, 1954.
[59] *Ibid.*
[60] *Ibid.*

Before the conclusion of the General Assembly discussions with the passage of the resolution noted above and an expression of formal approval of negotiations among the eight powers for the purpose of drafting a statute to create the Agency, American policy sought to regain some of its initial attractiveness. Thus, on November 15, 1954, the United States announced the allocation by the AEC of 220 pounds of purified uranium 235 as fuel to be available for experimentation to countries interested in participating in the international program.[61] We were immediately joined by Great Britain, which similarly allocated 44 pounds of fuel.[62] The Soviet Union, therefore, was challenged to demonstrate its own interest in "atoms for peace." Moreover, after the session, we indicated, through Mr. Eisenhower's special assistant for international atomic energy affairs and U.S. Representative for International Atomic Energy Agency negotiations (Morehead Patterson), that we would consider all the criticisms of the proposed Agency and probably would recommend, eventually at least, that the original nuclear treaty be adhered to by all sixty UN members plus the twenty-four members of the ten specialized UN agencies.[63] At this writing, however, no definite result has been achieved in the establishment of such an agency through negotiations among the eight western states. Discussions between the United States and the Soviet Union have taken place only intermittently. A primary obstacle has remained Soviet intransigence. The Soviet Union has continued to adhere to one of the two stipulations it had announced at the time it joined in the unanimous approval of the General Assembly resolution of December 1954—namely, that the proposed international agency be placed under the authority of the Security Council—in which a Great Power veto can be invoked. Moreover, though, it dropped the second condition—that the Geneva nuclear energy conference be open to such non-UN members as Communist China—Moscow also has formulated a network of bilateral atomic agreements with China, Poland, Czechoslovakia, Rumania, East Germany, Hungary, and Bulgaria. This "cold war" response to the American "agreements for cooperation" program recently has been supplemented by Soviet atomic *power* assistance offers to "neutral" states, like Egypt, to whom we have been offering no more than nuclear *research* aid.

The second portion of the United Nation's General Assembly resolution—the calling of an international nuclear science conference—was also a product of American initiative[64] and has, of course, been fulfilled by the Geneva meeting. Following quickly upon the heels of this authorization to convoke "an international technical conference of governments," Secretary-General Dag Hammarskjold established a seven-nation advisory committee and an international staff composed of top-flight scientists. This group met in January 1955 and formulated a tentative program which would commence with plenary discussions of world power resources and re-

[61] See N. Y. Times, Nov. 16, 1954, p. 1, col. 1.
[62] See *id.*, Nov. 17, 1954, p. 1, col. 3.
[63] See Frye, *Atoms for Peace: The First Step*, 34 FOREIGN POLICY BULLETIN 82 (1955).
[64] Secretary Dulles proposed it to the General Assembly on September 23, 1954. See N. Y. Times, Sept. 24, 1954, p. 1, col. 1.

quirements and then proceed to the consideration of exclusively scientific papers on reactor technology, radiation, medical and biological applications of nuclear energy. With a nonpolitical program thus outlined, the Secretary-General then extended invitations on February 1, 1955 to 84 nations to attend the conference and to submit, by July 1, papers which they would like to have read by their delegates. Seventy-two nations eventually accepted this invitation to attend the conference and, in addition, some seventeen countries submitted approximately 1,000 papers to be read. Space in the Palais des Nations for governmental exhibits was also allocated in accord with requests, and a special exhibition hall was arranged for additional commercial exhibits by organizations interested in launching international trade in nuclear equipment. Several pertinent UN specialized agencies like the FAO, WHO, and UNESCO were consulted during the planning of the conference, and they too were invited to send representatives. Thus, the arrangements for this first world conference on the peaceful uses of atomic energy were handled with commendable efficiency and impartiality. President Eisenhower's call, through Admiral Strauss, for a second such conference in the future[65] serves to demonstrate the extent to which at least this particular American foreign policy initiative in the nuclear field was effectively implemented by the United Nations.

Two things of outstanding interest and value have resulted from the Geneva Conference. First, and perhaps most important, has been the tremendous relaxation of national controls over atomic information. The leading countries actually engaged in what AEC Chairman Strauss said he hoped they would not enter—namely, "A scientific Olympic Games."[66] All manner of revelations concerning reactor technology and the scientific applications of nuclear fission were presented. Such competition to destroy a good deal of the secrecy which had handicapped international scientific exchange prior to Geneva not only served a useful purpose by partially unfreezing the nuclear "cold war," but also presented scientists from the less advanced countries with a great opportunity to expand their knowledge in a hurry.

The second significant result of Geneva was the formal launching of international atomic trade. For, the full-dress atomic trade fair demonstrated, in most vivid fashion, the preparations to compete for the atomic market which were now being made by business organizations in the United States, Britain, France, Belgium, the Netherlands, Italy, Switzerland, and West Germany. Outstanding in this commercial exposition was the obvious head start of the British, whose national interest in early atomic power had combined with the need to develop more specialized export markets in new fields where a competitive advantage could be achieved over other traders. The result was that, to paraphrase some disgruntled American businessmen on the scene, the British atomic merchants had the most space and the greatest number of specific atomic commodities available for sale, and their order

[65] See N. Y. Times, Aug. 17, 1955, p. 1, col. 5.

[66] Stanford, *The Two Genevas: Diplomatic and Atomic*, 34 FOREIGN POLICY BULLETIN 171 (1955).

books were on hand to consummate transactions. American businessmen, on the other hand, were not yet really prepared to compete both because of the governmental limitations under which they had to operate and because of the more leisurely approach taken towards atomic power development in the American nuclear program. Of additional interest in connection with this first commercial exhibition was the absence of Soviet nuclear wares for general sale. Instead of such "sordid" commercialism, Moscow announced that it would supply atomic assistance at cost, but only to its satellites. It is, thus, possible to say that both in terms of the information disclosed and atomic commodities available to interested countries, the Geneva Conference fulfillment of President Eisenhower's policy initiative in the fall of 1954 can be regarded as a Western victory. Everyone knew before Geneva that the Soviets could build bombs; the real question was their preparation to respond to the clamor of power-hungry peoples of the world for atomic assistance. The Geneva Conference revealed that the West was still the primary technological hope for underdeveloped areas. Since then, however, Soviet assistance offers outside the Communist orbit challenge the West to prove its willingness to fulfill this hope of the world's power-needy.

American foreign policy in the field of atomic energy has not only sponsored an International Atomic Energy Agency and the Geneva Conference, it has also engaged in a limited nuclear training program for scientists from friendly countries and has entered into an elaborate program of bilateral agreements with such countries in application of the "agreements for cooperation" portion of the Atomic Energy Act of 1954. The training program, to date, has been of two types: On March 13, 1955, a School of Nuclear Science and Engineering was opened by the AEC at the Argonne National Laboratory with an initial class composed of forty students from twenty countries, including nine representatives of American firms interested in atomic energy.[67] The curriculum of this school is atomic reactor technology, and its objective, as indicated by Morehead Patterson in his address at its inauguration, is to increase rapidly the "number of reactor engineers . . . in the free world . . . especially in those areas where such specialized skills may most readily be put to work."[68] The course work is based upon unclassified materials. This, then, is intended to be "the beginning of an extensive, permanent program of international education" to help develop in the noncommunist world an adequate body of "engineers and technicians who know how to design, build, and operate" atomic power plants.[69] Since its opening, the Argonne school has received a second class in the seven-month course, and President Eisenhower has announced that[70]

[67] Nations represented were Argentina, Australia, Belgium, Brazil, Egypt, France, Greece, Guatemala, Indonesia, Israel, Japan, Mexico, Pakistan, Philippines, Portugal, Spain, Sweden, Switzerland, and Thailand.

[68] Patterson, *Man's Benefits from the Atom*, 32 DEP'T STATE BULL. 553 (1955); reprinted in U. S. DEP'T STATE PUB. No. 5830, GENERAL FOREIGN POLICY SERIES 99 (1955).

[69] *Ibid.*

[70] *New Atomic Programs*, 4 U. S. DEP'T OF STATE FOREIGN POLICY BRIEFS, No. 24, at 1 (June 17, 1955).

. . . with prudent security considerations, we propose to make available to the peoples of such friendly nations as are prepared to invest their own funds in power reactors, access to and training in the technological processes of construction and operation for peaceful purposes.

The United States, thus, appears to have committed itself to indefinite governmental nuclear training for scientists from noncommunist countries. This educational program undoubtedly will be supplemented increasingly by American universities, themselves. There can be little question that this sort of program is and should be an important component of an atomic power foreign policy and that its attractiveness to technologically less well developed countries is great. Nonetheless, it is to be hoped that such training can at least be related to the activities of the proposed International Atomic Energy Agency, though not necessarily made available to communist country scientists until real international cooperation in nuclear energy is established.

The second type of nuclear training program for foreigners now engaged in by the American Government involves the study of radioisotope techniques. Though such four-week courses have been conducted at Oak Ridge, Tennessee, since 1948, as part of work contracted by the AEC to the Oak Ridge Institute of Nuclear Studies (an educational corporation of thirty-two southern colleges and universities), the first special session for friendly foreigners was inaugurated on May 2, 1955. Thirty-two scientists and technicians from twenty-one nations were accepted for it, with the facilities of the Department of State's Educational Exchange Program and of the Foreign Operations Administration (now ICA) utilized to conclude the arrangements. It can also be noted that the AEC has provided libraries of unclassified nuclear information to a number of countries, including Japan, Italy, and France for use by their scholars at home. This second type of training program should also be related ultimately to the activity of an International Atomic Energy Agency. Moreover, there would seem to be less justification for not including scientists from communist countries than in the reactor school, even if the program is continued under American auspices, since the information transmitted is unclassified and the benefits to be derived are primarily medical.

"Agreements for cooperation" have been entered into with twenty-six countries, as of July 15, 1955, and more undoubtedly will continue to be concluded. The important questions to be asked in connection with this steadily mounting network of bilateral executive agreements is, of course, their real significance. Do they actually represent important assistance to all these countries in the peacetime utilization of nuclear energy, or are they merely gestures devoid of much real meaning for peoples seriously interested in tapping the atom's benefits? Has the "agreements for cooperation" provision of the Atomic Energy Act of 1954 been employed, in other words, in such fashion that it has become the primary atomic foreign policy instrument it was intended to be?

A scrutiny of these agreements reveals that they are of four general types, to date: (1) those with nations which are at the very beginning of nuclear development, in

which agreements are restricted to American provision of unclassified data, a limited amount of fuel, some technical assistance, and access to private American companies for the erection, operation, and experimentation by the foreign nation with non-power research reactors; (2) those with more advanced nations which desire to obtain some specific item to facilitate research reactor programs which already are under way; (3) those with technologically advanced nations which also are leading suppliers to the United States of uranium, like Belgium or Canada, in which the agreement not only permits the exchange of both classified and unclassified information, but deals with power and propulsion reactors as well as research reactors and source materials; (4) those with technologically advanced nations, like the British, where real exchange of information, techniques, and devices on a mutually advantageous basis is possible, and unilateral American technical assistance is not the agreement's orientation.

The prototype for the most common form of our "agreements for cooperation" is the United States-Turkish arrangement.[71] Setting the pattern for the first type of agreement noted above, it contains the following significant provisions: Subject to the stipulation that no restricted data will be communicated and no materials, equipment, or devices transferred or services furnished in the transfer of any such items involving restricted data,[72] the parties agree to exchange information concerning the "design, construction and operation of research reactors and their use as research, development and engineering tools and in medical therapy" as well as to exchange information on related "health and safety problems" and on "the use of radioactive isotopes in physical and biological research, medical therapy, agriculture and industry."[73] Furthermore, the AEC promises to "lease to the Government of the Turkish Republic uranium enriched in the isotope U-235 . . . required as initial and replacement fuel in the operation of research reactors" whenever the Turkish Government either decides to construct them itself with AEC consultation or have them constructed for it by private individuals or groups under its jurisdiction which have been chosen in consultation with the AEC. Such private research reactors and their materials must, "at all times," be under "sufficient control" of the Turkish government. To implement this, the AEC agrees to provide up to six kilograms of uranium enriched up to a maximum of twenty per cent with U-235 and to replace this amount upon the return of fuel elements requiring such replacement.[74] In addition, the agreement pledges that the AEC "will sell or lease" to the Turkish government or authorized persons, in accord with supply, "such reactor materials, other than special nuclear materials, as are not obtainable on the commercial market and which are required in the construction and operation of research reactors in

[71] Agreement for Cooperation Concerning Civil Uses of Atomic Energy Between the Government of the United States of America and the Government of the Turkish Republic, 101 CONG. REC. 5140 (daily ed. May 11, 1955).

[72] *Id.*, art. V, at 5141.

[73] *Id.*, art. I, at 5141.

[74] *Id.*, art. II, at 5141.

Turkey."[75] Finally, the agreement indicates that "private individuals and private organizations in either the United States or Turkey may deal directly with private individuals and private organizations in the other country" and that the United States "will permit persons under its jurisdiction to transfer and export materials, including equipment and devices, to, and perform services for," the Turkish Government or authorized private Turkish organizations.[76] In exchange for the above, the Turkish government agrees to keep certain records of its use of this assistance and provides the guaranties required by the Atomic Energy Act of 1954.[77] In a concluding article, some definitions of terms are listed, including that of "research reactors," which are held to mean reactors[78]

> . . . designed for the production of neutrons and other radiations for general research and development purposes, medical therapy, or training in nuclear science and engineering. The term does not cover power reactors, power demonstration reactors, or reactors designed primarily for the production of special nuclear materials.

From the above agreement, it is obvious that no more than fundamental technical assistance is involved and that atomic power development is not considered. Agreements of this type, which comprise most of the thirty now negotiated, do no more than imply that atomic power development will some day be possible after the preliminary research reactor experimentation has been engaged in. Possibly in recognition of this material and psychological omission, subsequent agreements of this type now include actual expressions of hope that the particular agreement for cooperation will lead to further cooperation extending to the design, construction, and operation of power-producing reactors. Another recent innovation which has been announced by President Eisenhower is that he will recommend to the Congress that the United States also contribute half the cost of research reactors and, if the technical and material resources of a single country are inadequate for effective utilization of a research reactor, the United States will support a voluntary grouping of resources within a single region to acquire and operate such a reactor in common. It, thus, is possible to say that this form of agreement is one of fundamental nuclear education assistance, but not of atomic power development. Undoubtedly, unless coupled with indications of atomic power assistance at any early date, such agreements will not be as attractive to foreign countries as we would like them to be, particularly after the Geneva Conference and the general relaxation of information secrecy plus the availability for sale by the British of small and medium-sized power reactors and the new Soviet assistance offers.

The second type of agreement for cooperation entered into by the American Government, to date, involves the provision of some specific, but limited, assistance to nations which already have a reactor program of their own under way. Thus,

[75] *Id.*, art. III, at 5141.
[76] *Id.*, art. IV, at 5141.
[77] *Id.*, art. VI, at 5141.
[78] *Id.*, art. X(c), at 5141.

for example, Washington agreed to sell ten tons of heavy water to both India and and Italy, to be delivered during 1955 and 1956, for use as moderators in their first research reactors. During August 1955, the United States also sold to the Swiss Government the research reactor it established at the Geneva Conference for demonstration purposes, and it agreed to allow the Bavarian state government to purchase, in the United States, an atomic pile for research at Munich's Nuclear Physics Institute. Israel has been another customer interested in such types of limited research assistance, and, undoubtedly, many other countries which have advanced beyond the level of fundamental nuclear education will present similar requests, in increasing numbers, in the near future.

The agreement for cooperation between the United States and Belgium provides an example of the third type of understanding entered into under this program. With an introduction which describes the high degree of cooperation in the nuclear field which has prevailed between this country, Belgium, and the United Kingdom since 1940 and the willingness of the Belgian Government throughout this whole period to make its vast uranium ores in the Congo available to the British and ourselves, the agreement then notes our pledge from the outset that Belgium would "participate on equitable terms in the utilization of these ores" for power, once Britain and the United States decided to employ them for such purposes.[79] In repayment for this friendly and vital cooperation, article I of the agreement states that Belgium will receive from the AEC, "in the field of the peaceful uses of atomic energy, information and materials on terms as favorable as any other major uranium-supplying country except Canada." Following this adaptation of the most-favored-nation technique to atomic energy assistance, the agreement proceeds to specify its duration until July 31, 1965,[80] pledges an exchange of "general information on the over-all progress and economics of power reactor programs,"[81] and authorizes an exchange of "technological information required for the construction of specific reactors for the Belgian power program in Belgium, the Belgian Congo, and Ruanda-Urundi,"[82] with said exchange including "specifications for reactor materials," "properties of reactor materials," "reactor components," "reactor physics technology," "reactor engineering technology," and "environmental safety considerations."[83] The AEC also agrees to "receive selected security-cleared personnel from Belgium to work with and participate in the construction of the PWR reactor at Shippingport, Pennsylvania, and such other reactors as may be agreed . . . ,"[84] to "transmit . . . all essential information . . . making it possible for Belgium to design, construct, and operate a thermal, heterogeneous, pressurized light or heavy water

[79] Agreement for Cooperation Concerning the Civil Uses of Atomic Energy Between the Government of the United States of America and the Government of Belgium, 101 CONG. REC. 7377 (daily ed. June 20, 1955).

[80] *Id.*, art. II, at 7377.

[81] *Id.*, art. III(A)(1), at 7378.

[82] *Id.*, art. III(A)(2), at 7378.

[83] *Id.*, art. III(B)(1)(a)-(f), at 7378.

[84] *Id.*, art. III(B)(2), at 7378.

(boiling or non-boiling) reactor . . . ,"[85] to "communicate classified technical information required for the construction of any specific reactor" being seriously considered for metropolitan Belgium or the two African territories mentioned above,[86] and to "communicate classified information pertaining exclusively to any reactor-types, such as submarine, ship, aircraft, and certain package power reactors" when "these types of reactors warrant peacetime application. . . ."[87] The emphasis on peacetime application, incidentally, is clearly designated in art. III (C)(1), which excludes any exchange of restricted data pertaining primarily to atomic weapons or special nuclear materials. Other provisions of interest in this very elaborate agreement include authorization for private individuals and organizations in both countries to deal directly with the governments involved in implementing the arrangements,[88] the pledge that the AEC will sell "non-research quantities of materials" to Belgium "for use in research and power reactors" with the AEC reprocessing such fuel as necessary,[89] and also its promise to sell required quantities of heavy water.[90]

In exchange for all of this extensive American atomic research and power assistance, the Belgian Government undertakes in the agreement to continue to supply American uranium needs through the existing Combined Development Agency and the African Metals Corporation[91] and to obtain American consultation "on the international significance of any proposed transfer of any uranium and thorium ores or special nuclear materials to any country other than the United Kingdom,"[92] as well as to give the United States "an option to purchase any special nuclear materials produced in Belgium, the Belgian Congo, or Ruanda-Urundi, from materials sold" in accord with the agreement "which are in excess of Belgium's need . . . in its program for the peacetime use of atomic energy."[93] These undertakings by Belgium, in effect, tie up its vast uranium and thorium resources in an intergovernmentally sponsored and controlled cartel involving Belgium, the United States, and the United Kingdom and make the United States the primary supplier of Belgian nuclear fuel. The mutual benefits from this monopolistic arrangement appear to be very great, however. Nonetheless, when one adds to this agreement a similar one with Canada and Anglo-American arrangements involving access to South Africa's uranium, it becomes obvious that unless the United States and the United Kingdom are willing to act as suppliers not only of technological assistance but also of fuel, most of the world, under existing conditions, will be unable to operate elaborate atomic power systems either for want of the necessary raw materials or for lack of capacity to process them. The need for both a North Atlantic community coordinating agency and a really effective United Nations Atomic Energy Agency, of the type suggested earlier, thus, seems to have been enhanced by "agree-

[85] *Id.*, art. III (B)(3), at 7378.
[86] *Id.*, art. III(C)(2)(a), at 7378.
[87] *Id.*, art. III(C)(2)(b), at 7378.
[88] *Id.*, art. VI, at 7378.
[89] *Id.*, art. VII(A)(1) and (2), and art. VII(B), at 7378.
[90] *Id.*, art. VII(D), at 7379.
[91] *Id.*, art. VII(E), at 7379.
[92] *Id.*, art. VII(C), at 7379.
[93] *Ibid.*

ments for cooperation" between the United States and such raw material suppliers as Belgium.

The agreement between the United States and the United Kingdom, released by the Atomic Energy Commission on June 20, 1955, which represents the fourth type in the American "agreements-for-cooperation" network, is certainly one of the most important.[94] It also is a type which is least widely applicable, since it involves truly equal technological exchange between two of the three giants of nuclear energy. Having excluded data primarily concerned with military applications of atomic energy, this very significant agreement specifies an exchange of information between the AEC and the British Atomic Energy Authority involving reactors, extraction of "uranium and thorium," properties of nuclear materials, "technology" for the "production and utilization of materials," "health and safety,"[95] and "research materials and research facilities"[96] as well as the transfer of certain "equipment and devices,"[97] materials and services,[98] and patent rights[99] for a period of ten years. Classified information, however, "will be exchanged only when relevant to current or projected programs," while special nuclear material "will be exchanged . . . only for research purposes," even when primarily of a nonmilitary character.[100] Also of interest is a stipulation protecting private patent rights and information[101] and the effort made at a number of places to prevent the communication, either prematurely or at all, of restricted data concerning the production and utilization of nuclear material and isotopes.[102] Such things appear to indicate a large measure of caution by each party to avoid providing the other with any commercially useful information before competitive advantage has been derived from it in the international market.

III

WHERE WE STAND IN ATOMIC POWER FOREIGN POLICY

The preceding discussion of atomic power's international implications has emphasized several points in particular. One point has been that atomic power undoubtedly will have a great impact on human affairs but that such impact will be directly related to the present degree of technological development or lack of it found in most countries of the world. Industrially advanced nations are in the best position to employ the new energy source either to stabilize or to enhance their positions; currently underdeveloped lands generally are in the weakest position to utilize atomic power effectively in the very near future. This stems from the fact that the power

[94] Agreement for Cooperation on the Civil Uses of Atomic Energy Between the Government of the United States of America and the Government of the United Kingdom of Great Britain and Northern Ireland, 101 CONG. REC. 7371 (daily ed. June 20, 1955).

[95] *Id.*, art. II, at 7371.

[96] *Id.*, art. III, at 7372.

[97] *Id.*, art. V, at 7372.

[98] *Id.*, art. VI, at 7372.

[99] *Id.*, art. VII, at 7372.

[100] See the covering letters of Mr. Strauss and President Eisenhower appended to the agreement, as released by the AEC, 101 CONG. REC. 7371, 7373 (daily ed. June 20, 1955), and art. II(A)(3), *id.* at 7373.

[101] *Id.*, art. I(D), at 7371.

[102] See, *e.g.*, *id.*, art. II(D), at 7371.

derivable from the atom is utilizable only where a particular society is culturally receptive to it, can handle its social by-products, and is technologically prepared for it. Where significant deterrents now exist to technological progress of any type, such deterrents will also restrict the application of atomic power. Though some of the financial and technical obstacles can be alleviated by a really effective and supranational United Nations agency, even the creation of such a body (which is not presently blueprinted by the governments concerned with establishing an International Atomic Energy Agency) would not change the fact that the major industrial countries of the world, under present circumstances, will generally be the earliest and greatest beneficiaries of atomic power for the foreseeable future.

A second point of emphasis has been the necessity for the United States to formulate a full-blown and complex atomic power foreign policy. Such a policy must be well integrated with existing broad international objectives and particularly with our foreign economic, technical, and psychological policies. This integration, in turn, compels the development of programs for our Western allies, on the one hand, and the rest of the world on the other, with full attention accorded to the primary pressures and problems within each area as well as in the vital relations between them. In considering the extent to which we have fulfilled these requirements for a sound atomic power policy abroad, the conclusion reached has been that some accomplishment is apparent, but much remains to be done. The Atomic Energy Act of 1954 probably will have to be amended to facilitate private American atomic activity; it may also have to be amended to improve the President's ability to conduct a complete atomic power foreign policy. Moreover, the "agreements for cooperation" negotiated so far have done little more than offer some limited fundamental education for most of the nations involved. Though many are not yet prepared for more than this, international pressures undoubtedly will compel either early enhanced American assistance or, at least, more definite encouragement in the field of atomic power for power-hungry peoples. Our leadership position in world and nuclear affairs compels such broadening of the current program.

Finally, it has been noted that the United States has done little more than take the first few steps toward the necessary institutionalization of atomic power assistance and cooperation, internationally. Though we have recognized the demands of the situation and the requirements of our own position sufficiently well to play the international role of innovators of cooperation, a virile United Nations agency and a coordinating and regulatory agency for Western atomic activity have not yet been sponsored, though their contribution to world and Western well-being could be tremendous. Work on the skeleton for a sound American atomic power foreign policy, thus, has been commenced. We must now add some real flesh and muscle.

THE ROLE OF THE STATES IN ATOMIC DEVELOPMENT*

WILLIAM A. W. KREBS† AND ROBERT L. HAMILTON‡

I

Until comparatively recently, the development of the atomic energy industry has progressed almost as if state governments did not exist in the political organization of the country. Under the conditions which prevailed prior to 1954, it is not surprising that they played so insignificant a role. Activities in the field were almost exclusively a concern of the national government: almost all important facilities were owned by the national government; means of finance were provided by the national taxing power; major policy decisions were made by national officials and were hidden from state governments by a cloak of high security; and private organizations, to the extent they participated in the development of the industry (which they did to a very great extent), functioned primarily as agents of the national government. State governments, accordingly, could reasonably remain unconcerned.

Such detachment on the part of the states, however, is no longer tenable today. With the passage of the Atomic Energy Act of 1954,[1] there have occurred three important changes, each of which has far-reaching significance for state governments:[2]

First, a new legal class of private parties active in the atomic energy field has been created, namely, licensees under the 1954 act. Heretofore, private persons and organizations operated atomic energy facilities and possessed special nuclear material and source material as employees, agents, or contractors of the national govern-

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[1] 68 STAT. 921, 42 U.S.C.A. § 2011-281 (Supp. 1954). This statute is hereinafter referred to as the 1954 act.

[2] These changes add to, rather than replace, the existing pattern of legal control of peaceful atomic development; with respect to military applications of atomic energy, the pre-existing pattern subsists in the main.

ment. Henceforth, many of them will engage in similar activities in the capacity of licensees, incapable of invoking a federal immunity to shield themselves from state laws and regulations.

Second, the locus of initiative for many important decisions is shifting away from the national government. Heretofore, the power to determine the course of all major developments in the atomic energy field has rested exclusively with the national government. Henceforth, the capacity to make important decisions affecting atomic energy development will also be vested in hundreds of private corporations, state agencies, and state subdivisions.

A third change, attributable as much to the advancing state of atomic art as to the passage of the 1954 act, is in the kind and pace of atomic energy development. Nuclear reactors for the production of power are under construction. Increasingly they will be privately financed. Uses of radioactive isotopes are soaring. Various commercially attractive operations are on the horizon. Research fostered by both private and public funds is being pushed at an increasing tempo. And elements of competition are gradually making entrance upon the atomic scene.

From each of these changed conditions will emanate novel, challenging problems for state governments, some of which can be perceived today and some of which will undoubtedly remain unnoticed for a time. Although the full significance of these changes for the states can be foreseen only partially, it is possible, with respect to each of them, to indicate a measure of their impact. While separate analysis of these changes is necessary in order to understand their interplay, it should be remembered that in many situations, their effects will be overlapping and cumulative.

The Change in Legal Status

The great change in the law, relevant to this article, results from sections 41, 101, 103, and 104 of the 1954 act,[3] which, for the first time, permit private ownership of facilities designed to produce or utilize special nuclear material; and from sections 53 and 54,[4] which permit the AEC to make large quantities of special nuclear materials available to private parties for suitable purposes, under appropriate licenses issued by the Commission. The significance of this change can be illustrated by the case of a utility company which has decided to build and operate a power reactor. Unlike the contractor-operators at Hanford, Oak Ridge, or Savannah River, the utility company will, as a private entity rather than agent of the national government, be subject to state controls and policies on many sides, in addition to federal controls and policies—and in some cases, it may be caught in a cross-fire between them. Moreover, since "state controls and policies" are not necessarily a homogeneous, consistent set of regulations, but rather are more likely to be rules, regulations, and procedures formulated, in many instances, long prior to the Atomic Energy Act of 1954 and administered by a wide range of state agencies, the licensee may very well find them, as applied to its activities, at best uncoordinated and at worst

[3] 68 STAT. 928, 936, 937, 42 U.S.C.A. §§ 2051, 2131, 2133, 2134 (Supp. 1954).
[4] 68 STAT. 930, 931, 42 U.S.C.A. §§ 2073, 2074 (Supp. 1954).

quite at odds with one another. Since each state agency is ordinarily charged by one or more statutes with responsibility for a limited number of specific activities or conditions, such diversity should not be unexpected. A company engaging in the exploitation of atomic energy and having activities which bring it within the jurisdiction of several state agencies can, therefore, anticipate the necessity for threading a careful way through the fabric of state control.

Specific problems can be isolated by listing separately each executive department, agency, board, and commission in a particular state and determining whether such organization is charged with responsibility over one or more phases of the activities of atomic energy licensees within the state.[5] The following examples illustrate new state powers and responsibilities, some involving possible jurisdictional conflicts:

Heretofore, the AEC has had exclusive responsibility for controlling the radiation hazards created by the operation of its reactors. Once a private utility begins to operate a reactor, however, the state public health department, in addition to the AEC, may legitimately concern itself with possible hazards created for the public at large, and it may not apply the same safety standards as the AEC. In addition, the state labor department often has responsibilities for the occupational safety of the personnel at the installation, and it may apply safety standards which differ from those of both the AEC and the state public health department.[6] A real conflict may possibly arise between the regulations—*i.e.*, not only may one set be more stringent than another, but compliance with one set may necessarily involve violation of a different set.

Heretofore, there have been no reactors built by private utilities with their own money as additions to their generating capacity. Hence, state public utility commissions have not had responsibility for approving their construction or financing. Now, a state public utilities commission may have to issue a certificate of convenience and necessity before the utility can devote its funds to the construction of such a

[5] In Massachusetts, for example, each of the following state agencies will probably have to widen its field of activities to include problems arising from atomic energy development:

Public Health Department	State Planning Board
Department of Public Utilities	Port of Boston Authority
Department of Banking and Insurance	Airport Authorities
Labor Department	Aeronautics Commission
Public Safety Department	Highway Commission
Department of Industrial Accidents	Weather Control Commission
Department of Taxation	Agriculture Department
Industrial Development Commission	Department of Education
Commerce Department	Conservation Department
State Library Board	Commission on Uniform State Laws
State University Board	Commission on Interstate Cooperation.

This list includes organs of state government charged with educational and promotional functions as well as those with regulatory responsibility.

[6] In New York, for instance, the Department of Health adopted comprehensive regulations dealing with ionizing radiation, effective Sept. 1, 1955, N. Y. STATE SANITARY CODE c. XVI; the Department of Labor is in the process of adopting regulations establishing conditions for work in radiation areas, Proposed Industrial Code Rule No. 38, pending before the Board of Standards and Appeals; and the City of New York has additional regulations applicable to persons within its jurisdiction. SANITARY CODE, NEW YORK CITY DEP'T OF HEALTH §107a.

new facility. The state commission will have before it questions of considerable complexity and magnitude: Is it sound policy for the utility, at this time, to build into its system a generating facility of unknown reliability and clearly uneconomic function rather than wait five or ten years for the uncertainties to be resolved? What will be the proper allocation of the excess costs incurred in bringing atomic power into the system as between investors and rate payers, present and future? Are the consumers adequately protected against inadequate fuel-element supply? Can a utility participate in the construction and operation of a reactor located outside of the state and, therefore, beyond the jurisdiction of the commission?[7]

Heretofore, the location of new reactors was exclusively within the control of the AEC. Now, not only the state governments, but even local authorities and business interests will also be able to assert some degree of control. At the state level, one can expect the public utilities commission, the department of public health, and perhaps the state planning board, the department of conservation, and the department of agriculture to play a part in the ultimate decision. The local interests will find expression in special legislative acts, zoning regulations, building codes, private restrictions, and political mechanisms of many kinds. Whether these interests view a power reactor in the neighborhood as a prize to be sought or a nuisance to be abated may have considerable effect upon atomic power development in the state.

It is likely that the capacity of any given drainage basin to carry radioactive wastes from reactor coolant discharges is finite and will limit the number of power reactors which can be located on the particular river system involved. The adjustment of local, state, and interstate interests in the development of water supplies for agricultural, industrial, and consumer uses has, in the past, sometimes been regulated by interstate compact as well as by individual state agencies. State officials will, accordingly, play a central role in determining the best way in which to mesh such interests with the progressive utilization of such drainage basin capacity resulting from AEC approval of successive license applications.

Not all of the state activity engendered by the creation of the legal class of atomic energy licensees will be of a regulatory and control nature. The states have, or should have, as much interest in obtaining for their citizens the fruits and profits from the new industry as they have in guarding them against the potential hazards of careless utilization of atomic power. The appropriate state agencies now have good reason to undertake educational and promotional activities to call to the attention of the industrial leaders in their states the advantages to be gained through use of atomic power and radioactive isotopes in their operations, to encourage the education and training of their qualified citizens in the various specialities necessary to meet the demands of a growing industry, and to educate the public at large about the benefits to be obtained through the uses of atomic power. Such agencies can also publicize the adequacy of measures in effect to protect the public health and safety against potential radiation hazards.

[7] For a discussion of these and related problems, see Pike, *Model State Law for Atomic Energy Regulation*, 55 PUB. UTIL. FORT. 668 (1955).

In short, all of the state agencies which have any control over, or responsibility to promote, any one or more of the manifold activities in which a private concern may engage in its utilization of atomic energy for peaceful uses have a role to play in connection with the development of this new industry. The general objective of each state should be twofold: to secure for its citizens as many of the benefits of the industry as possible, and to protect its citizens from its potential hazards. One can safely assume that the AEC will remain alert to its responsibilities in both of these areas on a national basis. The time has come, however, for each state also to become alert to its own responsibilities within its borders and to take steps to see that its laws and policies, at all levels of government, are realistically adapted to meet the needs of the new situation.

The Change in Locus of Initiative

The second new condition which has been suggested as having an impact upon state responsibilities is the change in the locus of the initiative for important decisions about atomic energy development—from the AEC to the managements of many diverse organizations, private and public. The incidence of this change will fall primarily upon the developmental and promotional functions which many state governments have assumed, and which may be of unique importance in the pattern of development in a new industry.

So long as atomic energy remained nationally directed, decisions as to the erection of new facilities, their location, and design were matters within the exclusive control of the AEC and were influenced primarily by considerations of national strategic and economic policy and possibly, to some extent, by political forces. Similar decisions, when entertained now by the management of a public utility company, however, will undoubtedly be substantially influenced by other considerations and through other channels. It would seem safe to observe that probable economic consequences will weigh heavily in the scales. For example, the decision to build a costly power reactor which will operate at a loss in an electric utility system is likely to be made sooner by a company in a high power-cost area than by one in a low power-cost area; likewise, it will likely be made sooner by a company in a state which taxes utility income than by one in a state which taxes utility property. And management, looking for a site, is likely to be more favorably inclined toward a state where the development agency is well-informed and aggressive in atomic energy matters than toward a state where the government is indifferent or ignorant of the unique needs, interests, and problems of the atomic entrepreneur. Variations from state to state in tax structure, labor markets, and treatment of foreign corporations will all be weighed, along with numerous other factors, many of which will be unique for the organization making the decision, such as proximity to a university or a market, or physical integration with other components of the company's plants. In this complex, the attitudes of state governors, legislators, regulatory commissions, municipalities, and the responsible public opinion to which they must react and which they, in turn, can shape, are, in part, the determinants of that intangible

but significant "climate" of the state which can affect profoundly the speed and direction of its atomic growth.

To a certain extent, the states can participate directly in the development of atomic industry. In those states where power companies are run by municipalities or other governmental subdivisions, positive governmental leadership can pioneer the way, with the state treasury providing financial assistance in the interest of development for the benefit of all of its citizens. It is not inconceivable that a state might authorize construction of a power reactor in its own right as a means of meeting the high developmental costs of power reactors today, with an eye to distribution of the power produced and dissemination of the lessons in reactor technology learned to the existing power companies in its territory on some equitable basis. At the educational level, state universities can be supplied with research reactors, and research in problems of special interest to the state can be encouraged.[8] While the "climate" of the state, as assessed by a private organization weighing the comparative advantages of two or more states, is not something wholly under the control of the state government, there are areas in which the state government can take direct action.

The Change in Kind and Pace of Development.

The third new condition mentioned as having a profound impact upon state responsibilities is the change in the kind and pace of atomic energy development. By change "in kind," reference is made to the trend to private financing. It has been noted above that privately financed organizations will be the object of state regulatory and developmental activity. Private financing has further implications, however. In addition to creating private atomic activity to be developed and controlled, privately financed organizations will also create new private activity collateral to the atomic activity, which will engage further state action.

For example, the utility company proposing to operate a power reactor will have to have insurance. Clearly, the state and its municipalities have an interest in the type and extent of insurance coverage available for potential radiation hazards. What must be done to make available workmen's compensation insurance covering personnel at atomic energy plants on a realistic basis? What are the proper rates for fire and explosion insurance for a given type of reactor when no experience tables are available? Is state action the appropriate way to solve the problem raised by the need for public liability insurance in excess of the underwriting capacity of the private insurance industry? To what extent can a private utility company be permitted to be self-insured? Are present statutes of limitations of claims for injury arising out of radiation exposure realistic? State insurance commissions and other

[8] North Carolina, for example, has had a nuclear reactor in operation since 1953 at the North Carolina State College, where a program in nuclear engineering has been established and where, in July 1955, a special one-month course in Industrial Participation in Nuclear Power Developments was offered. On May 27, 1955, Florida, following suit, adopted a statute appropriating $500,000 to the University of Florida to engage in atomic research and acquire a reactor. Fla. Bill No. 304, Laws of 1955.

authorities clearly have a role to play in the effort to meet the pressing needs of the privately financed atomic energy industry for insurance of all kinds.[9]

Growing atomic enterprises will undoubtedly search for capital. Already, there has been considerable agitation for stricter controls over the issuance of securities by uranium mining corporations. What should be the policy of the states with respect to concerns whose key valuable asset is a revocable license to use government-owned special nuclear material, or to concerns having commercial activities all of which are still considered classified information? State "Blue Sky" commissions will have some part to play in this connection in atomic industrial development.

A fairly long-term demand for uranium appears to be a feature of mid-twentieth century life. An unprecedented uranium hunt, sparked by pegged federal prices for ore and bonus awards for new discoveries, has sent thousands of professionals and amateurs into the field. States in which such activity is under way may well have to face the question of whether their mining laws are adequate for the needs of the time.[10]

Experimentation in the processing of foods by use of ionizing radiation instead of heat is well under way today. When techniques become perfected, state agriculture and food and drug authorities will have new problems to face. While the AEC may have exclusive control of the processing operation from a health and safety point of view, there is a substantial question whether its authority or the scope of its effective administration extends to the channels of trade between wholesaler and corner grocery, once the food has left the processing plant.

As the number of industrial and other applications of atomic energy increases, there will be an increasing demand for new kinds of specially trained personnel. Experts, such as "health physicists," may be required to inspect or supervise certain operations. State civil service commissions and boards of professional registration will undoubtedly have to adjust their categories and establish new standards to accommodate the new species of atomic-age professionals.

As privately owned reactors come into operation, private institutions will gradually take over an increasing share of the business of producing radioactive isotopes. State highway, airway, and waterway authorities may have to exercise control over shipments of radioactive materials within the state over which the federal authorities exercise no jurisdiction.

Charitable institutions, such as hospitals, universities, and research foundations, utilize isotopes and are beginning to apply for licenses to build and operate reactors.[11] In many, if not a majority, of the states, such organizations enjoy some degree of

[9] See Preliminary Report of the Insurance Study Group to the Atomic Energy Commission, AEC Release No. 662, July 13, 1955.

[10] In Texas, such an evaluation has been made by a subcommittee of the Mineral Law Section of the State Bar of Texas, entitled MINERAL LAWS OF THE STATE OF TEXAS IN RELATION TO FISSIONABLE MATERIALS (1955).

[11] Five of nine applications received by the AEC from private parties in the first six months of 1955 for licenses to construct atomic energy facilities were submitted by charitable institutions. See AEC EIGHTEENTH SEMIANNUAL REP. 103 (1955).

immunity from tort claims.[12] In the light of the potential hazards involved in utilization of atomic energy, such legal immunity would appear to deserve careful reexamination by the state legislatures.

State civil defense authorities will be likely to have a great interest in the number of atomic energy installations in the state, the degree to which the state is sophisticated in the uses of atomic energy and the practices necessary for radiation hazard control, the availability of trained personnel and adequate radiation detection equipment, and the general level of understanding of radiation hazards at the command of the populace. Defense officials may well command political, if not legal, forces which will affect atomic energy development in any given area.

Private groups are already in competition with one another in the atomic business, with respect to both large projects, such as building power reactors, and small items, such as manufacturing radiation detection equipment. Competition inevitably leads to cost-consciousness, which, in turn, tends to induce competitors to economize by reducing expensive safety practices to minimum standards. Thus, complacency on the part of the states, whether reasoned or unreasoned, has become entirely inadequate today.

Although not a matter to be developed here, it should be pointed out that these collateral activities, which will inevitably occur with the private development of atomic energy and will prompt the types of state action noted above, will also invoke collateral federal activities by agencies other than the AEC. Regulations concerning the shipment of radioactive materials by the Interstate Commerce Commission, the Civil Aeronautics Board, and the Post Office Department are obvious examples.[13] Licensees who transmit or sell electric energy in interstate commerce are expressly made subject to the regulatory provisions of the Federal Power Act under section 272 of the Atomic Energy Act of 1954.[14] And it may be expected that other federal agencies will come to have a tangential part to play in the development and regulation of the industry.

What has been said about changed conditions of all kinds makes it evident that the state authorities have a significant role to play in the peacetime development of atomic energy. The accelerating pace of atomic development[15] underscores the

[12] See *Immunity of Nongovernmental Charity from Liability for Damages in Tort*, Annot., 25 A.L.R. 2d 29 (1952).

[13] 49 C.F.R. §§ 71-78 (Supp. 1954); 14 C.F.R. § 49 (1952); 39 C.F.R. § 35.16a (1949). Less obvious examples are Coast Guard Regulations, 46 C.F.R. § 146 (1953); and Labor Department Child Labor Regulations. 29 C.F.R. § 4.57 (Supp. 1954).

[14] 68 STAT. 960, 42 U.S.C.A. § 2019 (Supp. 1954).

[15] In the first six months of 1955, the AEC received nine applications for licenses to construct atomic energy facilities and three to use special nuclear materials for other purposes. See AEC EIGHTEENTH SEMIANNUAL REP. 103-04 (1955). The uses of radioactive isotopes are also steadily increasing: between August 2, 1946, and December 31, 1953, 12,162 curies of radioactive isotopes were distributed, see AEC SEVENTEENTH SEMIANNUAL REP. 93 (1955); between January 1 and November 30, 1954, 14,698 curies were distributed, *ibid.*; and in the first five months of 1955, 17,730 curies were distributed. See AEC EIGHTEENTH SEMIANNUAL REP. 121 (1955). Further, according to the *Survey of Materials, Equipment and Personnel for Atomic Energy Development*, published by the Atomic Industrial Forum, Inc., in April 1955, industry and other private organizations can be expected to spend $300-500 million of

immediacy with which many of these new problems must be dealt if a state is to experience an orderly, effective development and regulation of atomic energy within its borders instead of a disorderly patchwork of stop-gap measures and countermeasures, designed to meet specific problems here and there, without thorough comprehension of the total needs of the situation.

II

The basic question confronting a state, as a result of the passage of the Atomic Energy Act of 1954, is the proper delineation of the area over which the state now has power and responsibility for governmental action. Under our system of government, in which the national government is granted specified powers only but is supreme within its proper sphere of action, the entire residue of governmental powers and responsibilities inheres in the state governments, subject to certain constitutional limitations. Hence, the question invokes a twofold analysis: a determination of the type and scope of powers over atomic energy development vested in the national government by the Constitution; and a determination whether Congress, in passing the 1954 act, exercised its constitutional powers partially, fully, or exceeded them.

The constitutional basis upon which the act rests are several: Two great, sweeping powers of the national government which Congress utilized are the war power and the commerce power; lesser powers are the power to dispose of government property, the power to grant patents, the power to make arrangements with foreign nations, and probably others, including the power to provide for the general welfare, if that be a separate power.[16]

Because the 1954 act rests on several constitutional bases and is directed toward a number of specific ends, from the development of military potential to the granting of operator's licenses and the sale of electric power, it is not fruitful to speculate about the constitutional power of the national government in this area *in general*. Different parts of the statute will rest upon different configurations of constitutional powers. In fact, the Supreme Court, the final arbiter of questions concerning the extent of national and state powers under the Constitution, under its rule of entertaining only questions necessary to the solution of actual cases and controversies, can be expected to adjudicate specific disputes by determining, first, what part the 1954 act plays in the solution of each and, next, whether the provision of the act relied upon was within the constitutional competence of Congress. And since section 281 of the act[17] contains a separability clause, even if the Supreme Court should invalidate part of the act as exceeding the proper ambit of congressional power, other unrelated sections of the act would be unaffected thereby.

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nongovernmental funds on nuclear research and development during the five-year period 1954-58, inclusive. Moreover, government expenditures over the same period are likely to be several times this figure, exclusive of the weapons program, and are bound to produce technological advances capable of supporting industrial development on a constantly broadening basis. See *id.* at 8.

[16] See §§ 2 and 3 of the 1954 act, 68 STAT. 921, 923, 42 U.S.C.A. §§ 2012, 2013 (Supp. 1954), which set forth the congressional findings and the purpose of the act.

[17] 68 STAT. 960, 42 U.S.C.A. § 2011 note (Supp. 1954).

Assuming, however, that no part of the 1954 act will be held unconstitutional[18] (an assumption which seems to be perfectly safe[19]), there will still arise the following questions with respect to any given portion of the pattern of control:

> Did Congress intend to pre-empt certain areas of atomic energy regulation from which the states are to be precluded?
>
> If Congress so intended, what are the limits of the pre-empted areas?
>
> If Congress so intended, is the pre-emption effective immediately or only after the AEC has affirmatively acted to implement congressional intent?
>
> If Congress so intended, may the states regulate matters within the pre-empted areas if the AEC declines to regulate such matters, either expressly or by silence?
>
> If Congress so intended, may the states adopt rules consistent or identical with the federal regulation?

These are questions of statutory construction.[20] The 1954 act contains no clear expression of congressional intent on these matters with respect to peacetime development of atomic energy. Accordingly, to determine such questions, the courts may be expected to look to a number of other criteria in addition to the language of the act itself, namely: legislative history of the act;[21] whether the AEC has been given statutory directives or only authority;[22] policy considerations of uniformity versus diversity of regulation, and of centralized versus localized administration;[23] the extent to which an over-all scheme of federal regulation has been established;[24] the consequences of alternative possibilities;[25] and perhaps others.

As with the questions of constitutional power, the foregoing questions must be examined with respect to each area of proposed state action, rather than with respect to state action *in general*. Prior to final determination of such questions, by unambiguous expression of congressional intent or by definitive court decision, therefore, it is necessary to proceed with a painstaking analysis of the relevant factors involved in each proposed state action and apply the several criteria noted above in order to reach sound conclusions as to its proper scope.

[18] See, in this connection, Estep, *Federal Control of Health and Safety Standards in Peacetime Private Atomic Energy Activities*, 52 MICH. L. REV. 333 (1954), for a detailed discussion of the extent of congressional power to regulate a field which has traditionally been considered within the police powers of the states.

[19] This is not to say that the *application* of the statute may not, under some circumstances, be held to be unconstitutional, but only that it is unlikely that the Supreme Court will hold any part of the 1954 act to be invalid, per se, as violative of the Constitution.

[20] In most instances in the atomic energy field, it should be noted, we are not confronted with the problem of the scope of a state's power to act in the absence of congressional action. *Cf.* Cooley v. Board of Wardens, 19 U.S. (12 How.) 299 (1851).

[21] *Cf.* First Iowa Hydro-Electric Cooperative v. FPC, 328 U.S. 152 (1946).

[22] *Cf.* Oregon-Washington R.R. & Navigation Co. v. Washington, 270 U.S. 87 (1926). *But see* H. P. Welch Co. v. New Hampshire, 306 U.S. 79 (1939).

[23] *Cf.* Rice v. Santa Fe Elevator Corporation, 331 U.S. 218 (1947).

[24] *Cf.* Hines v. Davidowitz, 312 U.S. 52 (1941); Cloverleaf Butter Co. v. Patterson, 315 U.S. 148 (1942).

[25] *Cf.* First Iowa Hydro-Electric Cooperative v. FPC, *supra* note 21.

III

It is apparent that the first task of state authorities is to institute an orderly and thorough examination of the relationship of the changes described above upon each existing area of state function and to appraise imaginatively the need for state activity of types and in areas not now foreseen. Then, policies should be developed and mechanisms created to coordinate interstate and regional interests, and ways should be found to integrate those interests with the national atomic energy program.

To date, the state initiative with respect to atomic energy matters has been exercised in one of two general ways. Several states, which as of August 1955 included the New England states, Texas, Michigan, and Illinois, have been impressed with the need for study of the over-all problem of integrating state and national atomic energy programs and have launched special studies to provide the background for a coordinated, over-all approach to its solution. Other states, such as New York, New Jersey, Pennsylvania, California, North Carolina, Florida, and others, have been impressed with the need for specialized state action in one or more specific areas—for the most part, that of health and safety regulations—and have acted accordingly.[26] It will be useful to explore in some detail the problems which confront state authorities under both approaches.

That there would be an impact upon the states generally as a result of the atomic revolution now in progress was apparently first recognized in New England. In December 1953, a bill was introduced into the Massachusetts legislature to establish an atomic energy commission at the state level.[27] Its principal objective was to focus the attention of the state government upon the manifold opportunities and responsibilities that would arise in the event that amendments to the Atomic Energy Act of 1946, which were then under discussion in Congress, should become law. The bill was not enacted.

In February 1954, however, the New England Governors' Conference appointed a committee of twelve distinguished New England citizens to be a New England Committee on Atomic Energy,[28] whose duty it was to study and report on both the area's potentialities for atomic energy development and the opportunities and responsibilities of the state governments, industries, educational institutions, and citizens which should be anticipated. In both its interim report in December 1954 and its final report in July 1955, this Committee strongly recommended the enactment of a state atomic energy law during the 1955 sessions of the state legislatures.[29] The form of model state law proposed, together with the comments included in the report, is fully set forth in Appendix I.

The first objective of the model act, set forth in sections 1(a) and 2, is to estab-

[26] Mineral laws and developmental activities appear to be the next most popular areas for state action.

[27] Mass. H. Bill No. 851 (1953).

[28] Members of the Committee were: Karl T. Compton, Chairman (deceased); Hartley Rowe, Succeeding Chairman; Ralph D. Booth; Wallace Fay; Leslie R. Groves; Robert N. Haskell; Frank D. Merrill; Sumner Pike; Arthur L. Quirk; O. P. Robinson, Jr.; Shields Warren; and William Webster.

[29] See NEW ENGLAND COMMITTEE ON ATOMIC ENERGY, ATOMIC ENERGY AND NEW ENGLAND 59 (1955).

lish in the state a single, harmonious pattern of atomic energy regulation, under the aegis of either federal or state law. Section 2 contains substantive provisions designed both to insure automatic coordination of federal and state regulation and to eliminate the possibility of a jurisdictional no-man's land. It appears to be beyond question that this objective is highly desirable. Effective formulation of this objective in writing, however, presents difficult drafting problems.[80]

The second objective of the model act, set forth in sections 1(b) and 3, is to initiate an orderly, comprehensive review of state functions and responsibilities that may be affected by atomic energy development, by specifically requiring each major administrative unit of the state government to make such a review of its functions and to present appropriate recommendations on the subject to the governor. The importance of this type of action has already been noted, but it should further be observed that such an undertaking is no mean task. An adequate survey may well require the employment of persons possessing knowledge about atomic energy who are not ordinarily at the command of the administrative units making the studies. If fruitful results are to be achieved, not only must the appropriate agencies be given the responsibility for making such studies, but the agencies must be provided with enough money to insure that the studies are carried through, and the responsible official in each agency must be sufficiently apprised of the importance of the program so that it will be carried through without undue delay.

The third objective of the model act, set forth in section 4, is to provide a focus for the development of state policy in atomic energy matters by creating, on the staff of the governor, the office of Coordinator of Atomic Development Activities. The coordinator is to serve as adviser to the governor with respect to atomic industrial development within the state and as deputy of the governor in matters relating to atomic energy. He is given the duty of coordinating the studies, recommendations, and proposals of the departments of the state government and its subdivisions, and of providing liaison between his state, its sister states, and the AEC on atomic energy matters.

The Committee's comment concerning the creation of this office is worth repeating here for emphasis:

> This section is premised on the proposition that what is everybody's business is nobody's business and therefore seeks to make sure that atomic development and regulation is somebody's business. The office of the Coordinator . . . is proposed so that at least one person in a central position in the State Government will be responsible for seeing that the way is cleared for atomic development and that this is done without jeopardizing the public interest.

To this comment, it should be added that the success of such a scheme will turn, in large measure, upon the calibre of person selected for the position of coordinator and the financial resources placed at his disposal. Upon his shoulders, primarily, will lie the responsibility for the "climate" of the state in atomic energy matters.

[80] See *id.* at 63.

Probably a considerable part of his efforts will be directed along "public relations" lines, requiring him both to display initiative, imagination, and diplomacy and to do a great deal of assembling and disseminating of information pertinent to the field. There is a danger that the potential benefits to be achieved through the coordinator will be lost if the person selected is already loaded with business or governmental responsibilities and if he is given neither office nor staff nor salary commensurate with his position.[81] Even in states where the prospects for the use of atomic energy for power generation seem quite remote, there is bound to be a number of industrial or agricultural establishments which can benefit from utilization of new processes or techniques involving radioactive isotopes. On this point, one may well heed the recent advice of Sumner Pike, former AEC Commissioner:[82]

> The writer has had the experience of being fairly close to the subject [of atomic energy], since he was appointed to the original federal Atomic Energy Commission in 1946. About the only dependable lesson he has drawn from the experience is that the subject won't stay hitched, predictions are frequently obsolete before they get into print, and that constant vigilance, combined with flexibility, seems to be the only policy which pays off.

The achievement of constant vigilance combined with flexibility of approach in a constantly shifting, developing industrial field requires the full time services of high calibre personnel—not a paper assignment of responsibilities to a figurehead.

As of August 1955, the report of the New England Committee was the most comprehensive study published on the implications of atomic energy for the states. The Texas Legislative Council published a somewhat similar report in May 1955 on the implications of atomic energy development for Texas and included the New England Committee's draft of a model statute as an appendix to its report without endorsing or criticizing it.[83] A special committee appointed in Michigan by Governor Williams to study the problem for that state submitted a terse report in the spring of 1955, stating that state legislation in the field was premature.[84] The Illinois legislature in 1955 authorized the creation of an Atomic Energy Study Commission,[85] but, to date, this group has not had time to complete its work. Without legislative direction, the Governor of Texas appointed a special advisory committee on atomic energy in September 1955, and the Governor of New York appointed an Atomic Energy Council in November 1955.

Legislative response to the model statute proposed by the New England Committee has been favorable. Maine adopted a statute on March 18, 1955, closely patterned after the model law;[86] and New Hampshire[87] and Connecticut[88] did likewise

[81] So far, the New England states have not provided substantial financial support for their atomic energy programs. See notes 36, 37, 38, and 39 *infra*.

[82] Pike, *supra* note 7, at 673.

[83] See STAFF RESEARCH REPORT TO THE TEXAS LEGISLATIVE COUNCIL, IMPLICATIONS OF ATOMIC ENERGY FOR TEXAS (1955). A supplement to this report was issued in November 1955.

[84] See MICHIGAN ATOMIC ENERGY STUDY COMMITTEE, REPORT TO GOVERNOR WILLIAMS (1955).

[85] Ill. S. Bill No. 577, Laws of 1955.

[86] Me. Acts, 1955 c. 105. The coordinator is given no salary, and no money is appropriated for his use in performing his statutory duties.

[87] N. H. Acts, 1955, c. 281. The position of coordinator is to be conferred on the head of one of

on August 1 and August 11, respectively. Rhode Island, ahead of the other New England states, passed a state atomic energy law in January 1955, not based upon the model statute, but containing provision for a five-man state atomic energy commission, with duties similar to those given to the coordinator under the model statute.[39] No action has been taken in Vermont. And the model statute was not introduced in the 1955 session of the Massachusetts legislature; instead, it passed only a statute relative to radiological safety[40] and a resolve concerning study of location of "atomic plants" in Massachusetts.[41]

A discussion of state planning to accommodate its pre-existing policies and laws to the atomic age would be incomplete without mention of the points of contact which each state will have with the federal government. The AEC is not unaware of the problem of interleaving its policies with those of the states with respect to peaceful applications of atomic energy. In July 1955, it invited representatives of the governors of the forty-eight states to Washington to discuss the problems of state and federal cooperation.[41a] Particular emphasis was placed upon the health and safety regulations which the AEC had then just published in the *Federal Register*.[42] The meeting served as a good introductory session for the officials of the state and federal governments who will have to work together with these matters in the future. In the federal government, the primary contact point for the states is the Division of Civilian Application of the AEC, which superseded both the Licensing Division and the Industrial Liaison Branch of the Reactor Development Division. A secondary point of contact is the Inspection Division. A third is the Isotopes Division, which still maintains its own offices for processing applications for isotopes and its own inspection staff. For smooth working relations between nation and state and for most efficient development of the industry, it is important that the responsibility in the AEC for coordinating federal policy development with that of the states and for providing liaison between the AEC and the states be focused in one division of the agency. It is just as true with the national government as it is with the states that "what is everybody's business is nobody's business."

At present, the Division of Civilian Application is the primary office to which a state coordinator, or like official, should turn to attack the problems of federal-state adjustment. However, the responsibility for providing a qualified state official

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the existing state departments and is to be unpaid. One thousand dollars is appropriated for secretarial and similar expenses.

[38] Conn. Pub. Acts, June Spec. Sess., 1955, No. 46. The coordinator is paid twenty dollars a day while actually performing his functions as such, but otherwise is given no salary. Five thousand dollars is appropriated to carry out the purposes of the act.

[39] R. I. PUB. LAWS, 1955, c. 3416. The commissioners are to be unpaid. Five thousand dollars is appropriated for expenses for the first fifteen months. The commission is responsible for conducting studies, but no provision is made for coordinating federal and state jurisdiction over atomic energy activities.

[40] Mass. Acts and Resolves, 1955, c. 335.

[41] *Id.*, c. 88.

[41a] The AEC has made available a record of this meeting, entitled, *Conference of State Representatives on the AEC Licensing Program, July 13 and 14, 1955, Summary of Proceedings.*

[42] 20 FED. REG. 5101 (1955), amending 10 CFR Part 20.

to deal with those problems and to meet the AEC half-way remains with the states. Coordination cannot be achieved through federal action alone.

IV

The creation of a state coordinator or a state atomic energy commission is but a first step toward development of sound state policies for atomic energy. Such a step will not solve the many problems of adjustment noted above; it will only provide an agency responsible for their systematic solution. The problems remain to be worked out, one by one, with due consideration for the unique elements in each. State regulation for the protection of health and safety against the hazards of ionizing radiation is one major problem which is already being actively considered both by the federal government and by a number of states. We have, therefore, selected it for more extended treatment, as an example of the role states will play in atomic energy development.

From the initial mining of uranium ore to the final dispersal or decay of radioactive materials, by-products, and isotopes produced from it, certain risks of radiation exposure are present to the health and safety of both the workmen engaged in the industry and also, often, the general public at large. A workman in a uranium mine may, over a period of time, become ill from excessive inhalation of radon gas. Persons working in plants where uranium ore is processed, where U-235 is separated from U-238, where fuel elements for reactors are fabricated, or where reactors convert fissionable material into power all run a risk of accidental exposure to excessive radiation, either by direct radiation or by the uncontrolled escape of radioactive particles. The risks to the general public are highest in connection with the operation of the chemical separation plants and reactors and with the disposal of radioactive waste products. The largest present source of hazard from private atomic energy activity probably results from the widespread use of radioactive isotopes in industry and in medical research and therapy.

Regulation to insure adequate protection against the potential hazards of ionizing radiation is complicated because of several factors: radiation cannot be detected by human senses, but requires specialized equipment to be located and measured; exposure has a cumulative effect upon the human organism; different types of radioactive substances produce different types and intensities of radiation and have different rates of decay; different types of radiation affect the human body differently; each type of radiation is more hazardous to certain parts and organs of the human body than to the rest of it; deleterious effects of excessive exposure may not become evident in the human organism until long after exposure takes place; and the deleterious consequences may extend to future generations because of the effect of radiation upon genetic processes. Each of these factors tends to make the experts in the field conservative; consequently, adopted standards are likely to contain a large margin for error. In addition, the scientific community is constantly gaining additional experience in matters of radiation protection; the generally recognized standards of

safe practices to minimize radiation hazards are under constant re-evaluation, and, from time to time, they change.

One unique aspect of this problem is that it has existed for some time and has already been the subject of considerable attention. While information about the hazards of radiation has never been common knowledge, those of the scientific and medical professions who work with radiation have been aware of the hazards of ionizing radiation at least since the 1920's. In the United States, in 1929, there was established an Advisory Committee on X-Ray and Radium Protection, sponsored by the National Bureau of Standards. Its members were drawn from professional and commercial associations interested in the use of radioactive substances, primarily radium, and in the production of radiation by other means. Prior to World War II, this Committee had produced handbooks setting forth procedures for protection against specific hazards then encountered. Today the Committee is called the National Committee on Radiation Protection and is composed of experts in the field of radiation protection from the American College of Radiology, American Medical Association, American Radium Society, American Roentgen Ray Society, National Bureau of Standards, National Electrical Manufacturers Association, Radiological Society of North America, the United States Army, Navy, Air Force, Atomic Energy Commission, and Public Health Service, and certain representatives at large.[43] Since 1946, it has revised all of the earlier handbooks and produced a number of new ones.[44]

In the field of radiation protection, therefore, there exists a nationally recognized body of authority and cadre of established experts to guide the formulation of an effective code. The NCRP, itself, is a voluntary organization with no regulatory or control authority over anyone. It considers its main purpose to be the establishment of the basic principles and philosophy of radiation protection; and it volunteers to assist any group faced with the problem of establishing practices to reduce radiation hazards. Recently, the NCRP has extended its work beyond the field of establishment of basic principles. Under pressure from state officials who desire state regulation of radiation hazards, it is in the process of publishing a handbook, entitled *The Regulation of Radiation Exposure by Legislative Means,* which will contain not only the Committee's conclusions as to basic principles, but also suggested forms for a State Radiation Protection Act and for regulations under it.

[43] See Taylor, *State Control of Protection Against Ionizing Radiation*, 71 AM. J. ROENTGEN. 691, 698-99 (1954).

[44] The currently effective handbooks are: H 41, MEDICAL X-RAY PROTECTION UP TO TWO MILLION VOLTS (1949); H 42, SAFE HANDLING OF RADIOACTIVE ISOTOPES (1949); H 48, CONTROL AND REMOVAL OF RADIOACTIVE CONTAMINATION IN LABORATORIES (1951); H 49, RECOMMENDATIONS FOR THE WASTE DISPOSAL OF PHOSPHORUS-32 AND IODINE-131 FOR MEDICAL USERS (1951); H 51, RADIOLOGICAL MONITORING METHODS AND INSTRUMENTS (1952); H 52, MAXIMUM PERMISSIBLE AMOUNTS OF RADIOISOTOPES IN THE HUMAN BODY AND MAXIMUM PERMISSIBLE CONCENTRATIONS IN AIR AND WATER (1953); H 53, RECOMMENDATIONS FOR THE DISPOSAL OF CARBON-14 WASTES (1953); H 54, PROTECTION AGAINST RADIATIONS FROM RADIUM, COBALT-60, AND CESIUM-137 (1954); H 55, PERSONNEL PROTECTION FOR BETATRON-SYNCHROTRON RADIATIONS UP TO 100 MILLION ELECTRON VOLTS (1954); H 56, SAFE HANDLING OF CADAVERS CONTAINING RADIOACTIVE ISOTOPES (1953); H 58, RADIOACTIVE-WASTE DISPOSAL IN THE OCEAN (1954); H 59, PERMISSIBLE DOSE FROM EXTERNAL SOURCES OF IONIZING RADIATION (1954). See Taylor, *supra* note 43; at 701.

Before studying the role of the states in this field, however, one must take into account existing federal action. Working closely with the NCRP on the formulation of substantive provisions, the AEC published its proposed regulation on Standards for Protection against Radiation in the *Federal Register* in July 1955.[45] General authority for the promulgation of such a regulation is found in section 161(b) of the 1954 act,[46] which empowers the AEC to:

> . . . establish by rule, regulation, or order, such standards and instructions to govern the possession and use of special nuclear material, source material, and byproduct material as the Commission may deem necessary or desirable to promote the common defense and security or to protect health or to minimize danger to life or property. . . ;

as well as in specific provisions to similar effect dealing with arrangements to assist research,[47] production of special nuclear material,[48] the distribution of special nuclear material,[49] the distribution of source material,[50] the distribution of by-product material,[51] and the licensing of utilization and production facilities.[52]

The regulation contains three key substantive sections. The basic section, entitled Permissible Doses and Concentrations, specifies maximum permissible doses of radiation to which individuals in controlled areas may be exposed and maximum concentrations of radioactive material which may be permitted to be created in uncontrolled areas, to remain on exposed surfaces, or to be disposed of into air or water beyond the effective control of the licensee. The other two substantive sections, dealing with Hazard Control and Waste Disposal, contain certain required means (some specific, some general) to be followed in attaining the ends set forth in the preceding section. The section entitled Hazard Control requires, in general, that certain personnel likely to receive specified high doses of radiation or airborne radioactive material be required to use personnel monitoring equipment or respiratory protective equipment; that radiation areas and containers in which radioactive material is stored or transferred be posted with certain caution symbols and signs; that licensed material in noncontrolled areas be stored in locked and secured containers; and that individuals working with or in proximity to licensed material be instructed in the safe handling of such material, in the use of monitoring equipment and safety devices, and in emergency procedures. The third basic section of the regulation, entitled Waste Disposal, sets forth criteria to be observed in disposal of radioactive material into the ground, the ocean, and public sewers. The regulations are flexible, in that the AEC may grant to any licensee such exemptions from the requirements of the regulation as it determines are authorized by law and will not endanger life or

[45] See note 42 *supra*.
[46] 68 STAT. 948, 42 U.S.C.A. § 2201(b) (Supp. 1954).
[47] § 31(c), 68 STAT. 927, 42 U.S.C.A. § 2051(c) (Supp. 1954).
[48] § 45(b), (c), 68 STAT. 928, 42 U.S.C.A. § 2061(b), (c) (Supp. 1954).
[49] § 53(e)(7), 68 STAT. 930, 42 U.S.C.A. § 2073(e)(7) (Supp. 1954).
[50] § 63(b), 68 STAT. 933, 42 U.S.C.A. § 2093(b) (Supp. 1954).
[51] § 81, 68 STAT. 935, 42 U.S.C.A. § 2111 (Supp. 1954).
[52] §§ 103(b), (d), 104(a), (b), (c), (d), 68 STAT. 936, 937, 42 U.S.C.A. §§2133(b), (d), 2134(a), (b), (c), (d) (Supp. 1954).

property, and reserves the right to impose upon any licensee such additional requirements as it deems appropriate to protect health or minimize danger to life or property.

Two basic and quite different questions confront a state with respect to health and safety regulation for protection against potential radiation hazards: What action, if any, *can* a state legally take, in view of the above federal regulations? And what action, if any, *should* a given state take under the circumstances?

The first question raises legal issues which have been alluded to generally above. It is the opinion of the writers that to the extent that federal control over regulation for protection against radiation hazards has been asserted in the 1954 act, Congress intended that it be exclusive.[52] The following factors seem to compel this conclusion:

(1) Under the 1946 act, the national government clearly exercised exclusive control in this area. Modification of such a regime would, accordingly, seem to require explicit language to that effect. But there is no such language in the 1954 act; instead, extensive instructions are given to the AEC in this regard, and any possible role for the states is completely ignored.

(2) Radiation hazards, especially those arising out of operation of power reactors, are not local in nature, but can cause danger to multistate areas.

(3) Uniformity of regulation in this field is highly desirable.

(4) There is a relatively small number of persons in this country competent to assess potential radiation risks; and, as of the effective date of the 1954 act, the AEC had most of these persons at its command.

Thus, state regulation in this area which conflicts with the federal regulation would appear to be superseded thereby.[53] And, although no close analogies appear to be invocable, it seems clear that the Supreme Court would hold the 1954 act, so construed, to be a valid exercise of war and commerce powers, and not unconstitutional.[54]

In this situation, three clear-cut, rational, general courses can be followed by any state considering the problem of protecting its citizens from potential radiation hazards. The first is to do nothing, relying upon the protection afforded by the AEC regulations and practices. The second is to adopt laws and regulations to protect the state's citizens from potential radiation hazards not regulated by the AEC—to "take up the slack" in the federal program, to use a popular phrase. The third is to adopt laws and comprehensive regulations overlapping all federal control and also regulating the areas not touched by the federal authorities.

[52a] To date, the AEC has declined to adopt an official position on this question. See remarks prepared by Harold L. Price, Director, Division of Civilian Application, AEC, for presentation before the Atomic Industrial Forum, Sept. 27, 1955.

[53] It can be argued on the other hand, however, that Congress must explicitly provide that states' law will be superseded in order to pre-empt a field traditionally considered to be within the domain of state police powers—and the 1954 act contains no such language.

[54] See Estep, *supra* note 18.

"Doing nothing" may sound like an abdication of responsibility. It is not, however, or at least need not necessarily be so. The atomic energy industry is a new one. Concepts of standards of protection against radiation hazards have undergone many changes in recent years, and it is the opinion of experts in the field that as more experience is gained such standards will be continually re-examined and modified.[55] A state having no or few sources of potential radiation hazards outside the scope of federal regulation or having an insufficient number of adequately trained experts in the field of radiation safety upon whom it could call to administer any program might wisely choose not to embark on any special scheme of state regulation at this time. Other factors which a state might take into consideration in determining whether regulations of any sort are desirable are: whether the private organizations to be regulated are responsible or not; whether they have already established and are enforcing adequate control measures in their own establishments; the value to be gained by a cautious policy of waiting and seeing how the programs of other states fare; and finally, of course, whether there is political pressure from constituents for regulation.

A second possible state policy would be to adopt measures to protect the state's citizens from hazards with which the AEC is not concerned. Is there, in fact, an area left untouched by federal controls? The answer is clearly "yes." Neither the act nor the regulations purport to deal with naturally occurring radioactive substances other than source materials, such as radium and radon and their daughter products; nor with radiation produced from X-ray machines, fluoroscopic devices, and particle accelerators; nor with radioactive isotopes produced by particle accelerators and not distributed by the AEC. Nor does the AEC concern itself with health hazards connected with source materials prior to their delivery to the government or its agents for refining. These areas, then, constitute sources of potential hazard to the citizens of the states which may well deserve attention. In addition, although radioactive isotopes are made available to private users by the AEC only pursuant to licenses granted by the Isotopes Division, follow-up inspections of the users of such isotopes are made only on a spot-check basis, with priority given to the licensees who possess a large quantity of a particular isotope or who possess a particularly dangerous one. This type of inspection is used because of the large number of isotope shipments currently being made and because such inspection system has operated satisfactorily to date.[56] While it is illegal to transfer or acquire AEC-produced isotopes without license from the AEC, the spot-check type of inspection cannot insure that the isotopes do not pass into the possession of unlicensed persons who are not complying with the safety precautions required by the AEC. The considerations mentioned above as appropriate determinants of state action or inaction would also be applicable in this limited field of regulation.

The third possible course which a state might follow would be to adopt com-

[55] See generally NCRP, THE REGULATION OF RADIATION EXPOSURE BY LEGISLATIVE MEANS (to be published in December 1955).

[56] See Aebersold, *Address to Meeting of States' Representatives*, *op. cit. supra* note 41a, at 18.

prehensive radiation protection regulations overlapping the AEC regulations, with or without coverage of the additional area mentioned above. Such action would be based on the theory that although the national government's laws and regulations are to be accorded a pre-eminent status over state laws and regulations, the latter are not invalid so long as they are not inconsistent with the federal program. Some legal authority for such theory could be found in the fairly recent case of *California v. Zook*.[57] It would seeem, however, that such coincidental regulation has little to commend it. To the extent the area is covered by federal regulation, such state action is probably useless duplication. In addition, the legal status of such action is equivocal. Prior to the *Zook* case, the rule had been well established that such coincident state regulation was as ineffective as conflicting state regulation;[58] and the *Zook* case, a 5-4 decision, has never been relied upon by the Supreme Court since it was decided. Thus, it would appear to be a poor basis on which to erect a structure of state regulation in this field.

From the foregoing, it appears that the states in adopting their own health and safety regulations, would probably be best advised to limit themselves to dealing with radiation hazards outside the scope of the federal law and regulations.[59] Even in this limited area, the states should take care to impose regulations not for their own sake but only for the sake of controlling hazards that actually exist; and even then, only when sufficient numbers of adequately trained personnel are available to prepare and enforce them. Overzealousness may not only be fruitless, but may, in some cases, be harmful. If, for instance, the only particle accelerator in the state is located in a large university and operated only by a competent staff, enforced compliance with detailed, overconservative health and safety regulations might well cost more in terms of lost research effort than it would provide in terms of safeguards. Types of state control over radiation protection that are already being asserted are shown in Appendix II.

Adoption of the policy of self-restraint here recommended, however, need not deny the states a significant role in controlling radiation hazards within the perimeter of AEC responsibility. The states, however, must be willing to act in the capacity of agents of the national government rather than as sovereign principals. All of the states have one or more agencies charged with responsibility for state public health and industrial health and safety. Such organizations regularly check the state's water for impurities, its air for pollution, its industrial establishments for railings, lights, sanitary facilities, and so forth. To the extent that AEC inspectors make the same rounds while checking on uses of isotopes, or investigating concerns producing or utilizing special nuclear material, or disposing of waste materials, unnecessary

[57] 336 U.S. 725 (1949).

[58] Southern Ry. v. Indiana, 236 U.S. 439 (1915); Charlestown & Western Carolina R.R. v. Varnville Furniture Co., 237 U.S. 597 (1915).

[59] This policy appears to be consistent with the general position being taken by the NCRP in its forthcoming handbook, *The Regulation of Radiation Exposure by Legislative Means*, *supra* note 55. The NCRP, however, seems to entertain doubts (not shared by the writers) as to the power of the federal government to exclude the states from activity in the area federally regulated.

duplication of effort is involved. The AEC radiation control program, thus, might well be made more efficient and its limits of effective administration extended if the AEC inspections were made by the appropriate state agency whose officials already customarily monitor the locus in question. Such a procedure would be feasible only in states where the state health department or labor department or both have at their command sufficient numbers of adequately trained personnel; and the proficiency of its personnel would of course, determine the types of inspection which could be delegated to any given state agency.

Such a procedure appears to be authorized under section 161(f) of the 1954 act,[60] which provides that the Commission may:

> . . . with the consent of the agency concerned, utilize or employ the services . . . of any government agency or any state or local government, or voluntary or uncompensated personnel, to perform such functions on its behalf as may appear desirable.

Precedent for such use of state officials to carry out federal responsibilities to provide health and safety protection against radiation hazards may be found in the administration of the Walsh-Healey Act, section 1(c) of which specifies that no part of certain government contracts may be performed under substandard working conditions;[61] and section 4 of which contains a clause similar to section 161(f) of the Atomic Energy Act of 1954.[62] The United States Labor Department, which is charged with responsibility for the administration of the Walsh-Healey Act, has entered into written agreements with the appropriate state administrative agencies in more than twenty-five states making the state agency the sole agent of the federal government to conduct investigations of plants in the given state to determine compliance with the federal law and administrative standards adopted for its enforcement. Such cooperative federalism under the Walsh-Healey Act points the way for effective administration of federal health and safety regulations under the Atomic Energy Act of 1954.

The AEC should use state agencies to carry out the federal responsibilities for health and safety regulations wherever the AEC finds the state agency to be sufficiently equipped with well-trained persons to do the job. Such a procedure would eliminate unnecessary, irksome duplication, save taxpayers' money, free AEC officials for work in areas where state authorities cannot do the requisite job, and, in general, probably achieve the most effective protection against radiation hazards throughout the country.

For such a program to work, certain guideposts should be observed: the AEC must know the identity of the state officers who will be charged with federal investigations and must be satisfied with their capabilities; the AEC should pay the state agencies enough to meet the additional costs incurred by the agency in doing the AEC work; the types of inspection, the intervals between types of inspection, and

[60] 68 STAT. 948, 42 U.S.C.A. § 2201(f) (Supp. 1954).
[61] 49 STAT. 2036 (1936), as amended, 56 STAT. 277 (1942), 41 U.S.C. § 35(c) (1946).
[62] 49 STAT. 2038 (1936), 41 U.S.C. § 38 (1946).

the routine and special reports of inspection to be sent to the AEC must be clearly understood; the AEC must not undermine the state officials by making independent checks of the installations after the responsibility for them has been delegated to the state agency, except in emergency situations; enforcement authority should be retained by the AEC; and there should be a clearly designated state official responsible for administration of the state's obligations and a clearly designated AEC liaison official.

Such a program could probably be inaugurated in some states today with respect to isotope users and research reactor operators. Larger reactors, however, require a host of specialists to assess their potential hazards: physicists, engineers, sanitary engineers, meteorologists, hydrologists, and geologists in addition to health physicists. Accordingly, it does not seem likely that the AEC will delegate its responsibility for health and safety protection of such installations in the near future.

Initiative for such a program of cooperative federalism can come from the states as well as from the AEC. And now is the time for initiative. Once standard practices become adopted, inspectors hired by the AEC, and routines established, it will be almost impossible to modify the scheme. Furthermore, if there is a jurisdictional problem in the state, so that responsibility for occupational hygiene is not located in the public health agency, the AEC may be justifiably reluctant to use either the public health agency or the agency with responsibility for occupational hygiene until the two have joined forces to such an extent that the AEC may be sure that it is not involving itself in an inter-agency dispute. In a similar connection, the United States Labor Department and the United States Public Health Service have long had a written understanding with respect to their respective roles in the control and prevention of industrial health hazards.[63] There is no reason why state agencies could not reach a similar understanding with respect to their respective roles in radiation protection.

V

In summary, there are great changes rapidly taking place, both technologically and legally, in the development of atomic energy for industrial uses. The AEC still occupies a dominant position in atomic energy matters, but now there is also room for the states to formulate and implement state-wide policies, both for the encouragement of atomic industrial development within their borders and for the regulation of risks and hazards which may be unique to the industry. In the area of radiation protection, the states should take only such action as is consonant with their capabilities for effective enforcement, should cooperate with the AEC in enforcement of the comprehensive federal regulations rather than adopting conflicting or duplicating regulations, and should limit their own regulations to those hazards not covered by the AEC regulations. Other areas of state activity should be carefully

[63] See Memorandum to Form Basis of Joint Action in the Industrial Hygiene Field Between the Public Health Service and the Department of Labor (Bureau of Labor Standards), executed and dated Sept. 11, 1936, reaffirmed in 1953.

examined to determine both their exact relation to atomic energy development and the changes in law, governmental structure, and state policy necessary to further the best interests of the state in question and its citizens. To coordinate the studies, to insure that they are completed, to keep the governor and all department heads abreast of developments in atomic energy within the state and without, some such office as Coordinator of Atomic Energy Activities should be created, be given the appropriate powers and financial backing necessary to do the job, and be staffed by a person of vision and determination who is capable of assuring that atomic energy developments in the state are commensurate with its potential.

APPENDIX I

DRAFT OF AN ACT TO COORDINATE DEVELOPMENT AND REGULATORY ACTIVITIES RELATING TO THE PEACEFUL USES OF ATOMIC ENERGY

Be it enacted by etc.

Section 1. Declaration of Policy.

a. The state of endorses the action of the Congress of the United States in enacting the Atomic Energy Act of 1954 to institute a program to encourage the widespread participation in the development and utilization of atomic energy for peaceful purposes to the maximum extent consistent with the common defense and security and with the health and safety of the public; and therefore declares the policy of the State to be—

1. To cooperate actively in the program thus instituted; and

2. To the extent that the regulation of special nuclear materials and by-product materials, of production facilities and utilization facilities, and of persons operating such facilities may be within the jurisdiction of the State, to provide for the exercise of the State's regulatory authority so as to conform, as nearly as may be, to the Atomic Energy Act of 1954 and regulations issued thereunder, to the end that there may, in effect, be a single harmonious system of regulation within the State.

b. The State of recognizes that the development of industries producing or utilizing atomic energy may result in new conditions calling for changes in the laws of the State and in regulations issued thereunder with respect to health and safety, working conditions, workmen's compensation, transportation, public utilities, life, health, accident, fire, and casualty insurance, the conservation of natural resources, including wildlife, and the protection of streams, rivers, and airspace from pollution, and therefore declares the policy of the State to be—

1. To adapt its laws and regulations to meet the new conditions in ways that will encourage the healthy development of industries producing or utilizing atomic energy while at the same time protecting the public interest; and

2. To initiate continuing studies of the need for changes in the relevant laws and regulations of the State by the respective departments and agencies of the State which are responsible for their administration; and

3. To assure the coordination of the studies thus undertaken, particularly with other atomic industrial development activities of the State and with the development and regulatory activities of other States and of the Government of the United States.

Comment on Section 1:

The principal function of this section is to state the objectives of the state act. The section

does not seek to set forth findings to provide the bases to sustain the constitutionality of the statute since, in aligning the enacting State's policy with that of the Federal Government, the Act should enable the State to enjoy the benefit of the findings declared by Congress in the Atomic Energy Act of 1954.

Section 2. United States Licenses or Permits Required.

No person shall manufacture, construct, produce, transfer, acquire or possess any special nuclear material, by-product material, production facility, or utilization facility, or act as an operator of a production or utilization facility wholly within this State unless he shall have first obtained a license or permit for the activity in which he proposes to engage from the United States Atomic Energy Commission if, pursuant to the Atomic Energy Act of 1954, the Commission requires a license or permit to be obtained by persons proposing to engage in activities of the same type over which it has jurisdiction.

Comment on Section 2:

Some question has been raised whether, in the absence of a war emergency, the Federal Government's authority reaches as far as the licensing requirements of the 1954 Atomic Energy Act would extend it. If this doubt should prove valid, a gap would exist in regulatory power. Since the very possibility that such a gap may exist invites challenge, there is need for the enactment of a statutory provision designed to close the gap without imposing regulatory burdens in this field that State Governments are not equipped to carry and without giving rise to any conflict between State and Federal authority. This is the purpose which Section 2 is intended to fulfill.

If the Federal Government requires that a license or permit be obtained for any one of the type of atomic activities listed in Section 2 whenever that activity is carried out within the jurisdiction of the Federal Government, no person will be permitted to conduct that activity wholly within the State without first getting a Federal license or permit. It will therefore be of no advantage to a person seeking to escape compliance with Federal licensing requirements to raise jurisdictional issues.

If the Constitutional authority of the Federal Government is held to cover the listed activities, even when conducted wholly within a State, the State would have concurrent authority with the Federal Government unless the latter were held to have pre-empted the field.

If the Federal Government is held to have pre-empted the field, Section 2 will have been of no legal effect. However, it will not have interfered as a practical matter with the exercise of Federal authority, and it will have served as a deterrent to any search for a loophole in regulatory authority.

The question may be raised whether this section represents an unconstitutional delegation of future legislative power to the Federal Government by the State Government. Undoubtedly, from time to time, the Federal Government would announce new license requirements subsequent to the enactment of the State Act, and it may be argued that these new requirements represent a change in State law. Section 2 seems reasonably safe from attack, however, since it merely uses the possession of the Federal license as a fact indicating that the possessor is a fit person to engage in the activity to which the license applies. Section 2 is like a statute conferring certain privileges on persons who have been admitted to the bars of other States. Statutes of this sort are not considered unconstitutional by the fact that the requirements for admission to the bar may be changed by the other States in the future. And a State may condition the transport of intoxicating liquor through its territory on the fact that the consignee in another state may lawfully receive it. Carter v. Virginia, 321 U.S. 131 (1944).

The Opinion of the Justices, 239 Mass. 606, 133 N.E. 453 1921 deals with a legislative attempt to punish under State law violations of the Federal prohibition laws which, of course, were subject to change by the Congress. This was held invalid as an unlawful delegation of legislative power. One of the sections declared invalid contained a provision relating to Federal permits that was like that in Section 1. However, the same section also declared violations of the Federal law to be violations of State law and so was clearly invalid on the general ground of objection stated by the Court. There was no occasion to test the separability of the section's provisions, and so the good part fell with the bad.

The activities covered by Section 2 do not extend to "source materials," e.g. uranium ore. The handling of these is not attended by danger. The application of regulations is likely to turn on minor variations in ore content. Because of the resulting uncertainty, the adoption of State laws or regulations relating to source materials might, in effect, embarrass activities involving ores that contain minute quantities of uranium. Absent a showing or a need for protection, no action now seems called for.

Section 3. Conduct of Studies Concerning Changes in Laws and Regulations with a View to Atomic Industrial Development.

Each of the following departments and agencies of the State Government is directed to initiate and to pursue continuing studies as to the need, if any, for changes in the laws and regulations administered by it that would arise from the presence within the State of special nuclear materials and by-product materials and from the operation herein of production or utilization facilities, and, on the basis of such studies, to make such recommendations for the enactment of laws or amendments to law administered by it, and such proposals for amendments to the regulations issued by it, as may appear necessary and appropriate.

a. The Department of Public Health, particularly as to hazards, if any, to the public health and safety.

b. The Department of Labor, particularly as to hazardous working conditions, if any.

c. The Workmen's Compensation Commission, particularly as to the time and character of proof of claims of injuries and the extent of the compensation allowable therefor.

d. The Department of Public Highways, particularly as to the transportation of special nuclear materials and by-product materials on highways of the State.

e. The Public Utilities Commission, particularly as to the transportation of special nuclear materials and by-product materials by common carriers not in interstate commerce and as to the participation by public utilities subject to its jurisdiction in projects looking to the development of production or utilization facilities for industrial or commercial use.

f. The Department of Insurance, particularly as to the insurance of persons and property from hazards to life and property resulting from atomic development.

g. The Department of Conservation, particularly as to the hazards, if any, to the natural resources of the State, including wildlife, and as to the protection, if necessary, of rivers, streams, and airspace from pollution.

h. Such other departments and agencies (including departments and agencies of political subdivisions of the State) as the Governor may direct and for the purposes specified by him.

Comment on Section 3:

This section is premised on the supposition that study will disclose a need for a number of changes in existing laws and regulations to take care of new conditions created by atomic development for peaceful uses. The statutory directive will justify the use by the

several departments and agencies of their personnel in making the studies thus called for, a step that some of them might otherwise be reluctant to take.

In a number of states, important responsibilities affecting atomic energy developments may be vested in the governments of cities, counties and other political subdivisions of the State. For example, city planning and zoning boards and building commissioners exercise powers that could affect the location and construction of reactors within municipal limits. The language in brackets in paragraph (h) is intended to enable local governments to be brought within the range of the planning activities if this should be thought desirable. In any particular State, special provisions may be needed to reflect the legal relationships existing between the State and its subdivisions.

The names of departments and agencies used in this draft are given simply as examples. The list would not be accurate in any single State.

Section 4. Coordination of Studies and Development Activities.

a. The Governor and Council shall appoint a citizen of this State to serve as adviser to the Governor with respect to atomic industrial development within the State; as coordinator of the development and regulatory activities of the State relating to the industrial and commercial uses of atomic energy; and as deputy of the Governor in matters relating to atomic energy, including participation in the activities of any committee formed by the New England States to represent their interest in such matters and also cooperation with other States and with the Government of the United States. The person so appointed shall have the title of Coordinator of Atomic Development Activities.

b. The Coordinator of Atomic Development Activities shall have the duty of coordinating the studies, recommendations, and proposals of the several departments and agencies of the State (and its political subdivisions) required by Section 3 of this Act with each other and also with the programs and activities of the Department of Industrial Development of the State. So far as may be practicable, he shall coordinate the studies conducted, and the recommendations and proposals made, in this State with like activities in the New England and other States and with the policies and regulations of the United States Atomic Energy Commission. In carrying out his duties, he shall proceed in close cooperation with the Department of Industrial Development.

c. The several departments and agencies of the State (and its political subdivisions) which are directed by Section 3 of this Act to initiate and pursue continuing studies are further directed to keep the Coordinator of Atomic Development Activities fully and currently informed as to their activities relating to atomic energy. No regulation or amendment to a regulation applying specifically to an atomic energy matter which any such department or agency may propose to issue shall become effective until 30 days after it has been submitted to the Coordinator, unless, upon a finding of emergency need, the Governor by order waives all or any part of this 30-day period.

d. The Coordinator of Atomic Development Activities shall keep the Governor and Council and the several interested departments and agencies informed as to private and public activities affecting atomic industrial development and shall enlist their cooperation in taking action to further such development as is consistent with the health, safety and general welfare of this State.

e. The Coordinator of Atomic Development Activities shall be paid a salary of $ per annum.

Comment on Section 4:

This section is premised on the proposition that what is everybody's business is nobody's business and therefore seeks to make sure that atomic development and regulation is some-

body's business. The office of the Coordinator of Atomic Development Activities is proposed so that at least one person in a central position in the State Government will be responsible for seeing that the way is cleared for atomic development and that this is done without jeopardizing the public interest. If substantially similar statutes were enacted in all the New England states, the Coordinators could cooperate in developing a vigorous and sensible regional program. In any event, it is to be hoped that the present New England Committee on Atomic Energy will be succeeded by a similar body charged with encouraging a regional approach to the problems of atomic industrial development and any Coordinators appointed in the New England States could work closely with that organization.

Since the Coordinator's duties would cut across the fields of activity of many departments in the State Government, there is some risk that he would be by-passed by departments that were not alive to the need for cooperation. This problem would be accentuated if it is decided to bring departments and agencies of county, city and other local governments within the range of the Coordinator's activities. Accordingly, to make sure that the Coordinator can discharge his function effectively, it is provided in paragraph (c) that he be kept fully informed and given advance notice of proposed regulations so that he may make his views heard before possibly detrimental action can be taken. This requirement may be waived by the Governor. The provision has some analogy in the various provisions for advance notice of proposed action that must be given to the Joint Committee on Atomic Energy in Congress. However, the flow of information is not to be wholly in one direction. Paragraph (d) requires the Coordinator to keep the various agencies informed of atomic developments.

The work of the Coordinator would be on a full-time basis in some States, but in others part-time service would probably suffice. No attempt has therefore been made in paragraph (e) to specify either a salary for the Coordinator or the terms of his service.

Section 5. Injunction Proceedings.

Whenever, in the opinion of the Attorney General, any person is violating or is about to violate Section 2 of this Act, the Attorney General may apply to the appropriate court for an order enjoining the person from engaging or continuing to engage in the activity violative of this Act and upon a showing that such person has engaged, or is about to engage in any such activity, a permanent or temporary injunction, restraining order, or other order may be granted.

Comment on Section 5:

No criminal penalties have been provided for violation of Section 2. The cases, if any, are sure to be rare, and are likely to be intended to test the scope of Federal controls rather than to violate willfully a legal requirement known to be valid. To meet this situation, an injunction proceeding should suffice.

Section 6. Funds Provided.

There is hereby authorized to be appropriated the sum of $ for the salary of the Coordinator of Atomic Development Activities and for secretarial, travel, printing, and other necessary expenses incurred by him in the performance of his duties.

Section 7. Definitions.

As used in this Act,

a. The term "atomic energy" means all forms of energy released in the course of nuclear fission or nuclear transformation.

b. The term "by-product material" means any radioactive materials (except special

nuclear materials) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear materials.

c. The term "production facility" means (1) any equipment or device capable of the production of special nuclear material in such quantity as to be of significance to the common defense and security, or in such manner as to affect the health and safety of the public; or (2) any important component part especially designed for such equipment or device.

d. The term "special nuclear material" means (1) plutonium and uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Governor declares by order to be special nuclear material after the United States Atomic Energy Commission has determined the material to be such; or (2) any material artificially enriched by any of the foregoing.

e. The term "utilization facility" means (1) any equipment or device, except an atomic weapon, capable of making use of special nuclear materials in such quantity as to be of significance to the common defense and security, or in such manner as to affect the health and safety of the public, or peculiarly adapted for making use of atomic energy in such quantity as to be of significance to the common defense and security, or in such manner as to affect the health and safety of the public; or (2) any important component part especially designed for such equipment or device.

f. The term "operator" means any individual who manipulates the controls of a utilization or production facility.

Comment on Section 7:

The definitions contained in paragraphs (a) and (b) are indentical to the corresponding ones in the Atomic Energy Act of 1954. However, the definitions of "production facility" and "utilization facility" in paragraphs (c) and (e) respectively have been broadened by eliminating the provisions in the Federal Act which give the Commission power to narrow the category by rule. After the word "device" in the first line of (c) and "weapon" in the second line of (e), the Federal Act includes the phrase "determined by rule of the Commission to be" and also, after the word "device" at the end of each definition, it includes the phrase "as determined by the Commission." Both these phrases have been eliminated.

The reason these definitions have been revised in this way is that their retention in their original form would have left the applicability of Section 2 to depend on rules of the Atomic Energy Commission to be made in the future. This might have led to a decision that Section 2 represent an unconstitutional delegation of legislative power by the State to the Federal Government.

Fortunately, for the purposes of Section 2, there is no need to narrow the definitions as closely as the Federal Act requires since in no case would Section 2 impose any actual requirement for an intra-state activity unless the Federal Act required a license or permit for the same type of activity. The scope of the Federal Act thus becomes the final determinant of the scope of Section 2, but in a way that is believed to be constitutional.

In Section 3 the same terms are used in describing the areas of study to be pursued by the several departments and agencies of the State Government. Despite the fact that the areas are defined in this Act more broadly than the corresponding areas are defined in the Federal Act, there would be no reason for the departments and agencies to carry their studies to the logical extremes permitted by these State definitions.

The definition of "special nuclear material" in paragraph (d) differs from the Federal definition by giving the Governor power to enlarge the category, a power conferred by

the Federal Act on the Atomic Energy Commission. However the Governor is authorized to take this action only after the Commission has added the new material or materials to the category. This definition could not be treated as were the definitions of the facilities since it provided no broad category which the Commission had power to narrow. Fortunately, as a practical matter, there will in all probability be very few additions to the list so the Governor will not be burdened by the task of keeping the State Act in line with the Federal in this respect.

The Federal definition also explicitly excludes "source material," an exclusion that seems to have been added out of excess of caution. To introduce it here would require a definition of "source material." The precaution seems unnecessary.

Revised Draft
May 15, 1955.

APPENDIX II†

State	1	2	3	4	5	6	7	State	1	2	3	4	5	6	7
Alabama	..	..	..	..	..	X	..	Nebraska	..	..	..	..	..	X	..
Arizona	..	..	..	..	..	..	..	Nevada	..	..	..	..	..	..	..
Arkansas	..	..	..	..	X	..	X	New Hampshire	..	..	..	..	X	X	..
California	X	..	..	X	..	X	..	New Jersey	..	X	X	..	..	X	..
Colorado	..	..	..	..	X	X	X	New Mexico	..	..	..	..	..	X	X
Connecticut	X	..	X	..	X	X	..	New York	X	X	..	*	..	X	X
Delaware	..	X	..	..	..	..	..	North Carolina	..	..	..	..	..	..	..
Florida	..	..	..	..	X	..	..	North Dakota	..	..	..	..	..	..	..
Georgia	..	..	..	..	..	X	X	Ohio	..	..	..	..	..	..	..
Idaho	..	..	..	..	..	X	X	Oklahoma	..	..	..	..	..	X	..
Illinois	..	..	..	..	..	X	..	Oregon	..	X	..	..	..	X	..
Indiana	..	..	..	..	..	..	..	Pennsylvania	..	..	..	*	*	X	X
Iowa	..	..	..	..	..	..	..	Rhode Island	..	..	..	..	..	X	X
Kansas	..	..	X	..	..	X	X	South Carolina	..	..	..	..	..	..	..
Kentucky	..	..	*	*	..	..	..	South Dakota	..	..	..	..	..	..	..
Louisiana	..	..	..	..	..	..	X	Tennessee	..	..	..	..	..	..	..
Maine	..	..	..	..	..	..	..	Texas	..	X	..	..	..	X	X
Maryland	..	..	..	..	..	X	..	Utah	..	..	..	..	..	..	..
Massachusetts	X	..	..	..	..	X	..	Vermont	..	..	..	..	..	..	..
Michigan	..	..	..	..	..	X	..	Virginia	..	..	..	..	..	..	..
Minnesota	..	..	..	..	..	X	..	Washington	..	..	..	..	X	X	..
Mississippi	..	..	..	..	..	X	..	West Virginia	..	..	X	..	..	..	..
Missouri	..	..	..	..	..	X	..	Wisconsin	..	..	..	..	X	X	..
Montana	..	..	..	..	..	..	..	Wyoming	..	X	..	..	..	..	..

COLUMN 1: States with statutes specifically authorizing radiation control regulations or governing radiation hazards.
COLUMN 2: States with comprehensive public health regulations for control of ionizing radiation.
COLUMN 3: States with public health regulations for control of specified types or aspects of ionizing radiation.
COLUMN 4: States with comprehensive industrial hygiene regulations for control of ionizing radiation.
COLUMN 5: States with industrial hygiene regulations for control of specified types or aspects of ionizing radiation.
COLUMN 6: States reporting satisfactory, informal cooperation with the AEC in matters of inspection and control of isotope users.
COLUMN 7: States in which injuries resulting from excessive radiation exposure are compensable under workmen's compensation laws.

*Regulations have been proposed but not adopted.

†See also *Administrative Problems in Radiation Protection*, Nucleonics, Dec. 1954, p. 8, in which Drs. Tabershaw and Harris explore the essential elements of radiation protection regulations of a number of governmental, industrial, and other organizations.

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